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EDWARD J. NOLAN,
Recording Secretary.

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PROCEEDINGS

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PHILADELPHIA.

1884.

JANUARY 1, 1884.

The President, Dr. LEIDY, in the chair.

Fourteen persons present.

Ant infected with a Fungus.—Prof. LEIDY exhibited an ant, *Camponotus pennsylvanicus*, which was rigid, with limbs and antennæ extended, as in life, in which condition it was found under the bark of a decaying tree. It was infected with a fungus which spread through every part of the body.

Cassiterite from Black Hills, Dakota.—Prof. LEIDY exhibited specimens of tin ore submitted for examination by Mr. Eltonhead, who reports them to have been obtained at Black Hills, Dakota. They consisted of a mass of granite containing cassiterite, a fragment of quartz with the same, and a mass of pure cassiterite of about one pound weight. Prof. Leidy said he had also seen several pounds of large grains obtained from gold washings. From among these he had picked out several characteristic crystals.

JANUARY 8.

Mr. GEO. Y. SHOEMAKER in the chair.

Ten persons present.

A paper entitled "Some Phenomena in the Life-History of Clathrulina elegans," by Miss S. G. Foulke, was presented for publication.

Visual Organs of Lamellibranchs.—Dr. BENJAMIN SHARP reported on his work on the lamellibranch eye. He had examined the edge of the mantle of *Ostrea virginica* and *Mitilis edulis* of the Asiphonata, and the siphons of *Venus mercenaria*, *Mya arenaria*, *Mactra solidissima*, besides the forms already described for *Solen ensis* and *S. vagina* (Proc. of Academy of Nat. Sciences of Phila., 1883, pp. 248–9). The pigmented cells found in these parts are essentially the same as those found in *Solen ensis* and *S. vagina*. The smallest of all the cells were found in *Ostrea* and the largest in *Venus*. Experiments on these forms show their sensitiveness to light and shadow, and the cells showing the retinal character described leaves little doubt as to the power of vision. No nerves could be demonstrated passing direct to these cells, and probably those distributed to the general epidermis serve in transmitting the impressions. The visual power is so low that nerves have not been yet specialized for this purpose.

JANUARY 15.

The President, Dr. LEIDY, in the chair.

Twenty persons present.

A Phosphorescent Variety of Limestone.—Professor LEWIS gave a description of a remarkable substance found in one of the mountain mines of Utah, near Salt Lake City, sent to him some months ago by Professor Cope. It is a white rock which phosphoresces with a lurid red light whenever struck or scratched with a hard substance, and on that account has been called by the miners, *Hell-fire rock.*

It proves upon examination to be an almost perfectly pure carbonate of lime, containing occasionally slight impurities of iron, etc. It is a loose grained, white, crystalline limestone, the grains of which are but slightly coherent, giving the rock the appearance of a soft sandstone. Upon slight abrasion in the hand, it crumbles to form a coarse, calcareous sand. Under the microscope the rock appears as a loose mass of irregular, angular grains, which are nearly transparent, and which have a lustre resembling that of alum. Portions of the rock are colored slightly yellow by oxide of iron.

Its phosphorescent properties are very remarkable, entitling it to rank as a new variety of limestone. It was long ago noticed by Becquerel that some limestones were slightly phosphorescent after heating or insolation, but so far as known, no other limestone possesses this property in a degree at all approaching that

now described, the phosphorescence of which is nearly as strong as that of fluor spar.

Phosphorescence is developed when the rock is either struck, scratched or heated. Upon using metal, glass or any other hard substance to strike or to scratch it, a deep red light is emitted, which continues sometimes for several seconds after the blow. Rubbing with other fragments or grinding in a mortar developed a white light. The most remarkable phosphorescence is developed by heating a fragment of the limestone in a glass tube over a flame. It then glows with a deep red light which lasts for a minute or more after withdrawing the flame. The color of the light emitted resembles that of a red-hot body. Several seconds before dying out, the light becomes white or bluish white. Upon cooling and subsequent heating, phosphorescence is again developed in the same fragment, but much more feebly and for a shorter period, and after two or three such heatings, its phosphorescence is destroyed.

Experiments made by the speaker upon the temperature at which "Hell-fire rock" became phosphorescent, showed that phosphorescence occurred at a temperature somewhat under 500° F. Small fragments phosphoresced much more quickly than large ones. The lurid red light produced by a blow from a hammer varied in duration of visibility according to the strength of the blow. The phosphorescence produced by a slight touch lasted only half a second, while a sharp blow produced a light which remained more than twenty seconds after the blow was given. Doubtless, a blow with a miner's pick upon the rock would cause still longer phosphorescence.

It was found that the phosphorescence developed by heating occurred nearly contemporaneously with the decrepitation of the calcite, and this fact may be of value in theoretical considerations.

A search through the collection of the Academy for limestones having similar properties resulted in finding a limestone from Kaghberry, India, which glowed with a strong yellow phosphorescent light when heated. No phosphorescence was produced by friction alone, as in the case of the Utah limestone. It was of great interest to find that this Indian limestone, and this one alone of all in the collection, had the precise external characters of that from Utah. It had the same crystalline structure and state of aggregation, crumbling readily in the fingers, and resembling a sandstone. It was labeled "Phosphorescent Sandstone," although containing no siliceous sand.

This similarity of external characters between the two phosphorescent limestones is certainly more than a coincidence. It confirms Becquerel's view that phosphorescence depends upon physical rather than chemical conditions. He has shown that when Aragonite is calcined, fused with sulphur and then heated, it phosphoresces with a green light; whereas calcite, similarly

treated, gives a yellow light; from which he concludes that the different colors depend upon different crystalline states, the composition remaining the same.

The speaker had been fortunate enough to observe the rare phenomenon of the phosphorescence of snow, having seen a snow-covered Alpine mountain shining at night as though illuminated by moonlight. This beautiful appearance lasted for about half an hour only, and was confined to a single mountain. Here again the phosphorescence, although of quite a different kind from either of those mentioned above, was purely physical, depending upon the assumption of a certain crystalline condition of the snow.

In general, the phosphorescence of a substance may be said to depend upon an alteration in its molecular state of aggregation. In the case of "Hell-fire rock" it appears to be the result of a disturbance of its loosely aggregated crystalline particles, whether such disturbance be produced by percussion, friction, heat or decrepitation.

The New Jersey Coast after the storm of Jan. 8, 1884.—Professor LEIDY stated that, in company with Dr. Sharp and Mr. Ford, he had made a trip to Atlantic City, N. J., to observe the result of the recent storm on the marine animals of our coast. The shore at the highest line reached by the tides was for miles covered with incalculable numbers of the Beach-clam, *Mactra solidissima*. These in many places formed extensive patches actually closely paved with the clams. Besides those visible, it is probable as many or more were covered by the sand thrown up with the clams. Until this evidence of the storm, he had no suspicion that the mollusk was so exceedingly abundant on the coast, though he had been well aware that it was very common, and had repeatedly seen large quantities thrown on shore under similar circumstances. With the Mactra were other mollusks, and, though numerous enough, they appeared to be few compared with the former. These were *Fulgur carica* and *F. canaliculata*, *Natica heros* and *N. duplicata*, and *Nassa obsoleta*. Hermit crabs were also numerous, *Eupagurus pollicaris* in shells of Natica and Fulgur, and *E. longicarpus* in shells of Nassa The former shells had attached abundance of *Crepidula unguiformis*, and occasionally on the outside a *C. fornicata*. Of other crabs, the Spider-crab, *Libinia canaliculata* and *Platyonichus ocellatus* were frequent. A few half-grown Horse-shoe crabs, *Limulus polyphemus*, were also observed. A few bunches of *Mytilus edulis* were occasionally met with.

It seemed remarkable that certain common mollusks were conspicuously absent, as the Oyster, *Ostrea virginiana*, the Clam, *Venus mercenaria*, the Squirt-clam, *Mya arenaria*, and the Horse mussel, *Modiola plicatula*. Scarcely any annelides were observed,

except masses of dead *Serpula* invested with *Eschara variabilis*. There were also no echinoderms, except one, the *Caudina arenata*, which occurred in some places in considerable numbers. This, it was believed, is the first time the animal has been observed on the coast of New Jersey. The specimens presented were collected by Mr. Ford. They usually range from three to four or five inches in length; but several were upwards of six inches, and over an inch at the thicker portion of the body.

It is an interesting question as to what becomes of the vast quantities of *Mactra* and other shells incessantly cast on shore. Storms annually oblige the ocean to contribute from its inexhaustible stores, multitudes of mollusks and other animals to the sandy beach. By exposure to the influence of the weather, the air, the sun, the rain, frosts and other violence, the calcareous shells are broken and decomposed, and in a comparatively few years entirely disappear. Carbonic acid, of the rain-water, must be a potent agent in their ultimate solution as it percolates through the sands. While the beach receives its constant supplies of shells, no trace of these is to be found in the sands immediately back of the shore; which sands in former times received the same incessant contributions. For similar reasons, no doubt, calcareous fossils are comparatively rare in sandstones, though in many cases their impressions are well preserved.

Flora of North America.—At the meeting of the Botanical Section of the Academy, held on January 14, Dr. ASA GRAY spoke of the progress of the forthcoming portion of the Synoptical Flora of North America, and of the occasions which had led to the publication of the middle portions in advance of the earlier. It had seemed important now to secure the results of the many years of study which he had given to the large and difficult order of Compositæ, which will form the bulk of the forthcoming part. He spoke of the perplexities attendant upon the accurate definition of generic divisions in this order, and especially of properly discriminating the species of such genera as *Aster* and *Solidago*. He had no idea that he had really solved the difficulties of this kind, or that any one would entirely solve them; but he had done his best. He could himself name the species of *Solidago*, and he could name a good many Asters; but he doubted whether he had enabled other botanists to name them. Being asked whether his views respecting the limitation of species had not undergone some change, in the direction of admitting more species now than formerly, he admitted that this was probably the case. He still held to what might be termed the Linnæan conception of species, that they were to be taken in a broad sense and expected to comprise various forms, which might or might not be classified into varieties. But whereas, in his younger days, species were thought to be independent creations, and the real differences,

if we could find them, supposed to be absolute, we now look upon allied species as having descended from a common ancient stock, of which intermediate forms have died out, and therefore do not expect that allied forms, on the whole distinct and definable, should be completely unconnected by certain links or vestiges of links. Moreover, it used to be thought that hybrids were necessarily sterile, but it is now known that some hybrids are fertile, and that their offspring, fertilized by either parent, are generally fertile; that in this way intermediate forms between two species may originate; and it is clear that the two species ought not to be reduced to one on account of such intermediate forms. Dr. Gray referred to *Rosa*, *Rubus* and *Hieracium*, in the Old World, as genera in which no two botanists who had studied them could agree as to what were species; one school reducing them to very few, which they can define only by disregarding certain intermediate forms; the other multiplying them by hundreds, and characterizing them by distinctions which might serve for the specimens in hand, but which failed with every new collection. This necessitated either the formation of a still finer-drawn set of species, or the falling back to the broader Linnæan conception of a species. The latter alternative had been generally followed in this country, and Dr. Gray hoped that the coming American botanists would incline to this view in the treatment of our critical genera.

Relation of Medullary Rays to the Strength of Timber.—Dr. ROTHROCK called attention to some experiments made by Mr. Frank Day, in the laboratory of the University of Penna., on the relation of the medullary ray to the strength of timber. Mr. Day had found that it required just about twice as much force (say 1130 pounds) to pull apart a square inch of live oak, if the force ran parallel to these rays as if the force were applied at right-angles to them.

What is true of the live oak was also largely true of other timbers. The buttonwood (*Platanus occidentalis*) was remarkable for the development of its medullary rays, and also for the difficulty in splitting that wood at right-angles to them.

Mr. Day's experiments also proved that there existed great differences in the quality of the material of the woody fibre; for in timber where the relative proportion of wood and ducts could well be compared, and where the fibres were of equal size throughout, differences in strength were to be found.

Botanical Notes. Double Flowers in Gelsemium nitidum; Euonymus Japonicus; Development of Fruit of Opuntia; Helianthus tuberosus; Carya glabra.—Mr. MEEHAN exhibited two specimens of double flowers of *Gelsemium nitidum*, one found wild in Georgia, the other in Alabama. One was straw-colored, the other deep yellow. He remarked that many double flowers in

gardens, credited to the florists' skill, were wildlings which had been taken into cultivation.

Mr. Meehan also remarked that *Euonymus radicans*, under culture from Japan, is believed by some modern botanists to be but a variety of *E. Japonicus.* He exhibited branches of the latter which had been produced by the former. They were not varieties, but simply frutescent and radicant forms of each other.

The speaker exhibited specimens of *Opuntia frutescens*, var. *longispina*, in which fruit had formed, though no flowers had appeared, the scarcely developed sepals and petals having been thrown off the apex in infancy. A regular gradation from perfect branches to these fruits was exhibited, some of those most closely related to perfectly formed fruit having a tendency to the red coloring which marked the fruits. Occasion was taken to emphasize the morphological doctrine, that fruits like apples and pears are but arrested branches.

In continuation, Mr. Meehan reintroduced specimens exhibited at a former meeting, showing that the roots of a supposed Jerusalem artichoke, wild near Philadelphia, and supposed to have been in some past time an escape from gardens, had characteristics somewhat different from the form now under culture in the vicinity, and inquired whether this might be what has been hitherto known as *Helianthus doronocoides*, which Dr. Gray had demonstrated some years ago in Silliman's Journal, to be the parent of *H. tuberosus.* If so, it might prove that this species was indigenous to Eastern Pennsylvania.

Dr. Asa Gray did not think the species was indigenous here. He rather suspected that the form now wild had once been the cultivated one, and that the ones now in use had been introduced since. He remarked that he had been working among the roots of different species of the genus, during the past autumn, some of which he found had merely fleshy roots, like those of *Dahlia*, making no runners; others had runners developed into true tubers.

Mr. Meehan also exhibited some nuts of *Carya glabra* Torr. (*C. porcina* Nutt.) which had been brought in by one of his seed collectors from a tree in the woods in the vicinity of Philadelphia. They had two or sometimes three nuts in a single exocarp, as in the manner of *Castanea vesca*, the common chestnut. The collector was under the impression that all the nuts borne by the tree were of a similar character.

Dr. Asa Gray remarked that this occurrence of two or three nuts of *Carya* within the same husk, either separate or partly coherent, was of much morphological significance. Specimens like these had been sent to him several years ago, said to have been collected in Montgomery Co., Penna., with the remark that the tree bore a good many such abnormal fruits; Dr. Gray believed that the conclusion to which they inevitably pointed had

not yet been published. It was, however, communicated to Dr. Engelmann, along with a portion of his specimens, at least five years ago. The conclusion drawn was the following: The husk, or so-called exocarp, of *Carya*, is an *involucre*, usually containing a single female flower, and connate with its ovary; its true morphology is revealed when, as in this case, it contains two or three flowers. The stone or shell of the nut is the whole pericarp in *Carya* as much as in *Corylus*. In the former genus it becomes free from the four-valved involucre at maturity; in *Juglans* the congenital union is more permanent, forming a drupaceous accessory fruit, of which the fleshy part is involucre, the bony part is pericarp. This view directly homologizes the *Juglandaceæ* with the *Cupuliferæ*.

The following was ordered to be printed :—

SOME PHENOMENA IN THE LIFE-HISTORY OF CLATHRULINA ELEGANS.

BY SARA GWENDOLEN FOULKE.

While collecting infusoria among *Lemna* and the leaves of the yellow pond-lily, in a ditch on Brandywine Creek, Chester county, Pennsylvania, the writer was so fortunate as to secure large numbers of that beautiful Heliozoan, *Clathrulina elegans.*

This rhizopod was attached in myriads to the roots of the *Lemna*, the groups in many cases being composed of above twenty-five colony-stocks, so matted together by the twisting of the pedicels, and so surrounded by waste matter, as completely to conceal at that point the supporting root-fibre.

The animals were in a most active condition, feeding by means of their characteristic pseudopodial rays, and multiplying so freely by self-division, that the water was full of the Actinophrys-like bodies, and almost every capsule supported from one to ten young individuals.

After being kept in captivity for two weeks, the large social groups had decreased in number, although solitary individuals were much more numerous. Reproduction was still going on, but not so freely, and by more varied methods. The phenomena exhibited during the act of reproduction are the subject of this communication.

The modes of reproduction are four in number, two of these being slightly similar, while the others essentially differ in character. These four modes are: *first*, by division; *second*, by the instantaneous throwing off of a small mass of sarcode; *third*, by the transformation of the body into flagellate monads; and *fourth*, by the formation and liberation of minute germs. By the *first* mode, and this is the most common, the sarcode mass within the capsule withdraws its rays, constricts, and divides into from two to four granular masses, which, after a varying period of rest, pass out from the capsule and instantly shoot forth pseudopodial rays on all sides, thus assuming the appearance of an *Actinophrys sol.* These Actinophrys-like bodies after a time develop a protoplasmic stalk, or pedicel, by which they attach themselves, usually to the parent capsule. A thin film of protoplasm is then thrown out and subtended by the rays, at a short distance from the body, and this, by development and secretion,

becomes the latticed siliceous capsule. The pedicel also becomes more rigid, though always retaining a degree of flexibleness. This manner of reproduction was first described by Cienkowski, the great Russian observer, and discoverer of *Clathrulina elegans* (see Leidy's Rhizopods of North America).

In the *second* mode of reproduction, the rays are not withdrawn, nor does the body divide, but the sarcode becomes finally vacuolate, presenting knob-like projections. Suddenly a small mass of sarcode, usually one of the knob-like projections, detaches itself, and, passing out of the capsule, shoots out rays and develops, though more slowly, in the manner described above. This continues until the parent body is much reduced in size, when the rays again protrude and the animal returns to its normal condition.

The *third* mode of reproduction is by the formation and liberation of minute germs. In this state, also, the rays are not withdrawn, but the body of the *Clathrulina* becomes filled with minute green particles, which, even before liberation, exhibit active motion. A number of these are expelled, enclosed in a thin protoplasmic film or globular sac, which bursts shortly, and the liberated germs swim away. The development of these germs, after this point, is yet to be followed.

The *fourth* mode is still more remarkable, and is also significant in bringing to light a new phase in the life-history of the Heliozoa. The *Clathrulina* in which these phenomena were first observed, withdrew its rays and divided into four parts, as in the ordinary method; but the sarcode, instead of becoming granular and of a rough surface, grew smoother and more transparent. Then followed a period of quiescence;—in this case of five or six hours duration, although in other instances lasting three days and nights; after which one of the four parts began slowly to emerge from the capsule, a second following a few moments later.

While passing through the capsule, these masses of sarcode seemed to be of a thicker consistence than the similar bodies, which, in the ordinary method, instantly assume the Actinophrys form. After both had passed completely through, for nearly a minute they lay quiet, gradually elongating meanwhile. Then a tremor became visible at one end, and a short prolongation of the sarcode appeared waving to and fro. This elongated at the same time into a flagellum, the vibrations becoming more rapid, until at the same moment both the liberated monads darted away through the water. They were followed for about ten

minutes, when both were lost to sight among a mass of sediment, and the fear of mistaking one of the common monads for them led the observer to abandon the search. Returning to the parent capsule, a third monad was found to have escaped in the meantime. After twenty-four minutes quiescence, the fourth body in its turn approached the wall of the capsule, emerged, developed a flagellum, and swam away, a free monad. With a one-half inch objective this one was closely watched, and the following details noted: body oval, transparent; nucleus present, dark-colored and situated near the centre; a pulsating pink vesicle, situated posteriorly; and a flagellum slightly longer than the body.

For one hour and fifty-eight minutes the monad swam in all directions, usually in concentric, ever widening circles, then suddenly darting off at a tangent to begin again in a new spot. At the end of this time, in its course it touched one of the free young *Clathrulina*, and, to prevent it being used as food by its cannibal relation, the glass cover of the live-box was tapped, so that the current produced carried the monad a short distance away, where it remained almost motionless several seconds.

By a change to a power of three hundred and fifty diameters, the monad was shown to attach the top of its flagellum to the glass and revolve swiftly for a few moments, when instantly the whole body became spherical, rays were shot out, and the transformed monad was in no point, except that of size, to be distinguished from its Actinophrys-like cousin, whose career had been so different. In some cases the monads remained attached by the flagellum, using it as a pedicel. The whole development, from the time when the monad began its free life, occupied two hours and some seconds.

This mode of reproduction secures a more widespread distribution of the young than would be possible did this depend on the sluggish Actinophrys form. It seems reasonable to suppose that this is a wise provision for the perpetuation of the species, should adverse conditions of life arise; and also to prevent an undue accumulation of the animals within a circumscribed space.

The tendency of these rhizopods to attach themselves to the parent capsule, a result of the inertness of the Actinophrys form of young; together with the fact that this mode of reproduction was apparently induced by a lengthened captivity, necessarily the source of adverse conditions, would point to the reasonableness of the above conclusions.

JANUARY 22.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

The death of James C. Hand, a member, was announced.

A paper entitled "On Semper's Method of Making Dried Preparations," by Dr. Benj. Sharp, was presented for publication.

Indian Mounds on the Miami River.—Mr. F. W. PUTNAM, Curator of the Peabody Museum of American Archæology and Ethnology, Cambridge, Mass., gave an account of the explorations now in progress by himself and Dr. C. L. Metz, of an interesting group of earthworks in the Little Miami valley. It consists of twelve mounds enclosed by an embankment of earth which runs across the lowland and connects by a graded way with a circular embankment on a hill thirty feet high, within which are two other mounds. The mounds have proved to be very important, as several are constructed in a peculiar manner. In two of the mounds circular stone walls were found, and from these walls stones have been laid, covering in the central portions of the mounds. Several of the mounds were stratified, and contained basins, or "altars," of burnt clay, upon which were thousands of objects more or less injured by fire. Burnt human remains were found in several of the mounds, and in others were skeletons, showing that both methods of disposing of the dead were resorted to. Many interesting objects were found with the skeletons. The most important discoveries were made on the "altars," which contained, among other things, many works of art, including small terra-cotta figures representing men and women, carved stone dishes in the form of animals, and various objects cut from mica, among them a serpent and a grotesque human face.

There were also found a large number of objects made of native copper, and several of native or meteoric iron. This is the first time that native iron has been found in the mounds. Several copper ornaments were covered with silver, and a few fragments of a thin sheet of hammered native gold were also obtained. Over fifty thousand pearls were found on one of the altars, with thousands of other ornaments made of bone, shell, and the teeth of animals. Among the latter were large canine teeth of bears, which may prove to be those of the grizzly bear, or some species larger than the black bear. Several chipped points of obsidian and a number of singular pendants made in a peculiar manner from a micaceous schist, were on one of the altars.

Another important discovery was mentioned as having just been made, but not yet worked out. This consisted of a series

of large pits, six or seven feet deep, in the natural clay below the burnt clay layer of one of the mounds. These pits had long clay tubes, or flues, extending from them, and there is some evidence that these pits were used as places of cremation, but this must be determined by further and careful study. A number of photographs were exhibited, illustrating the structure of the mounds and the objects found in them.

Note on Manayunkia speciosa.—Mr. EDW. POTTS reported having found specimens of *Manayunkia speciosa* Leidy, amongst material collected in the Schuylkill River, above Fairmount dam; thus determining what had previously admitted of a shade of doubt, the strictly fresh-water habitat of this species. In continuation he narrated some points within his own observation, supplementary to Dr. Leidy's description.

The branchial organs (tentacles) appeared to him to be grouped upon two processes on each of the lateral lophophores, eight each in the upper or more dorsal groups, and six or possibly more in each of the others. Beside these, there is a single pair placed centrally upon the dorsal portion of the head, and a similar pair opposite, which do not seem to be connected with either of these groups. The whole number is therefore 32–36. The alternating contractions and dilatations of the vessels conveying the green blood through the dorsal pair above mentioned are very conspicuous.

While the general appearance of this crown of tentacles, when expanded, is somewhat similar to that of a polyzoan, there is a noticeable difference in the effect produced by the motion of their cilia. In the latter a powerful *incurrent* bears food particles, etc., towards the mouth as a vortex; in the former case, while the motion draws these particles from without or behind the circle towards the tentacles, the moment they pass between them they are influenced by an *excurrent* bearing them forcibly away.

This outflowing current is further shown by the fact that excrementitious matters are drawn rapidly forward through the tube, and ejected at its anterior extremity.

As food, therefore, cannot be sucked into the mouth of the worm, we find that it is carried in. Acceptable particles which touch the tentacles are grasped by the cilia, and rapidly passed down amongst them in near contact with the tentacle into grooves at the base of the above-mentioned processes, and thence into the digestive tract.

Beside the specimens above mentioned from the Schuylkill River, Mr. Potts has had recently under observation a considerable number, say fifteen or twenty, from the pond near Absecom. One of these, to which most of his time had been devoted, had been kept for many days isolated in a microscopic stage tank. While in this situation it, for some reason, left its old tube and formed another, giving him the opportunity to observe the

character of the latter, and the method of its construction. In its earliest stages it is a transparent, smooth, and homogeneous slime-like excretion, within which the worm may be very clearly seen, as it works its way forward or drags itself backward by means of its podal hooks and spines. Later on, the anterior extremity thickens and becomes more and more opaque, and, as Dr. Leidy has observed, "feebly annulated," presumably from the adherence of effete particles, and their compression by the repeated withdrawal of the ciliated tentacles into the mouth of the tube. This method of prolongation must continue during the residence of the worm, and in consequence, if supported, it may sometimes reach a length which is several times that of its inhabitant.

JANUARY 29.

The President, Dr. LEIDY, in the chair.

Thirty-three persons present.

Fossil Bones from Louisiana.—Prof. LEIDY directed attention to a collection of fossil bones, which have been submitted to his examination by the Smithsonian Institution. They were obtained by Mr. William Crooks, at the mine of the American Salt Company, near New Iberia, La. They chiefly consist of remains of *Mastodon americanus*, of *Equus major*, of *Equus*, not distinguishable from those of the domestic horse, and of *Mylodon harlani*. Of *Mastodon* the collection contained well preserved molar teeth, and characteristic fragments of bones. Of the *Equus major*, there are vertebræ, fragments of long bones, and a number of teeth. The molars are characterized by their comparatively large size and complexity of arrangement in the enamel folding, especially of the upper molars. Of *Mylodon* there are several molar teeth, vertebræ and other bones, mostly fragments. Among the bones are two mature and well-preserved tibiæ, the best specimens yet discovered of the species. They are identical in form and size with those of *M. robustus*; indicating *M. harlani* to have been a species of the same size as the former. The extreme length of the tibia internally is nine inches; breadth across the head, seven inches; across the distal extremity, five and one-half inches. Further collections were anticipated from the same locality.

Foraminifera in the Drift of Minnesota.—Prof. LEIDY stated that he had recently received for examination, from Mr. B. W. Thomas, of Chicago, several glass slips with mounted specimens of sand. These were obtained by washing clay from the boulder drift of Meeker Co., Minnesota. In the specimens, Prof. Leidy

recognized some well-preserved and characteristic foraminifera, of which two forms appeared identical with *Textularia globulosa* and *Rotalia globulosa*, now living in the Atlantic Ocean. The fossils Mr. Thomas supposes to be derived from a soft yellow rock, cretaceous shale and lignite, forming part of the drift. He also reports the finding of fragments of marine diatomes in the clay.

The following were elected members :—

Benjamin R. Smith, Rev. Wayland Hoyt, Wm. Thomson, M.D., H. W. Stelwagon, M. D., John Struthers, D. G. Brinton, M. D., Thomas H. Fenton, M. D., and Miss Helen Abbott.

The following were elected correspondents :—

Karl A. Zittel, of Munich; Marquis de Gaston de Saporto, of Aix; Quintino Sella, of Rome; August Daubrie, of Paris; and Albert Gaudry, of Paris.

The following was ordered to be printed :—

ON SEMPER'S METHOD OF MAKING DRIED PREPARATIONS.

BY DR. BENJAMIN SHARP.

Although this admirable method has been known and published for a number of years, it does not seem to have met with general acceptance. Many persons, indeed, with whom I have spoken do not seem to know of it at all, and for that reason I do not think it amiss to give an account of it here.

I have had the pleasure of working under Professor C. Semper, the discoverer of this method, for two years, and have seen, as well as prepared, many specimens. I have seen some specimens that have been prepared by this method over ten years ago, and not the slightest change has taken place in them, and they look as beautiful as those just finished.

The method requires close attention at certain stages, and the result depends upon the amount of care bestowed; the end, when successful, fully repays any amount of care that has been taken.

Nearly any animal or animal tissue may be prepared by this method; some require naturally more care than others—of fish, where there is a large quantity of fatty substance present, the greatest care is to be taken.

Dissections of animals are especially adapted for this method, and most of Prof. Semper's preparations are in this form. If desirable, when finished, the different systems of organs may be colored and thus serve as beautiful specimens for demonstration.

The object to be prepared is first placed in a solution of chromic acid of about $\frac{1}{4}$ to $\frac{1}{2}$ per cent., or even 1 per cent. In the case of dissections, these are to be prepared after the animal is killed and then placed in a dissecting tray, the bottom of which is filled with wax, so that different parts may be pinned out and thus better exposed to view; the tray may be then filled with the chromic acid solution.

The size and consistency of the object determines the length of time that it should remain in the solution; Annelides, small Gastropoda or Lamellibranchiata, small organs, as kidneys, etc., or small vertebrates, as frogs, mice, birds, etc., should remain in from six to eight hours; larger animals or organs from eight to twenty-four.

The chromic acid is merely to kill the tissues, and at the same

time hardens them somewhat. Any other of the hardening fluids may be used, and for these I can refer the reader to Dr. C. O. Whitman's paper on this subject, which appeared in the *American Naturalist*, (vol. xvi, 1882, pp. 697, 772). Chromic acid, however, is the reagent that Prof. Semper always uses, and it seems to answer every purpose.

After the object has been left a sufficient length of time in the fluid, this is poured off and the vessel filled with water, which should be constantly changed until there is no yellow color either in the object or in the water. In other words, as much of the acid must be withdrawn as possible. This part of the process is considerably shortened by allowing a current of water to flow through the vessel. This stage takes from ten to twenty hours, or even more.

After this is completed the object is placed in weak alcohol, from 30 to 40 per cent., for at least a day; when the specimen is quite small, ten or fifteen hours are sufficient. Then the alcohol may be strengthened to 60 or 70 per cent., and the object remain in this for two or three days (with larger objects, a week).

The object may now be placed in strong alcohol, from 90 to 95 per cent., for about the same length of time as with the 70 per cent. It may, indeed, remain here for weeks or months. I have often taken specimens that had been well preserved, after having been for a year in 90 per cent. alcohol, with as good a result as if freshly prepared.

In cases of dissections where parts have been pinned apart, after passing through the 70 per cent. alcohol stage, they may be taken carefully out of the trays, and the rest of the process gone through with in closely stopped bottles, for they are at this point quite stiff.

When objects have remained a sufficient length of time in the strong alcohol, they are placed in absolute alcohol. If the strong alcohol be changed once or twice, it will necessarily save the absolute alcohol to some extent.

This stage of absolute alcohol is the most critical part of the whole process. *Absolutely* every particle of the water must be removed, and the secret of the whole success depends on this one point. If any water be left in the tissue, it will become spotted and eventually spoil. I feel positive that those who have tried this method and have failed to produce satisfactory results, have

not been careful enough to remove every particle of water. I always take the precaution of changing the absolute alcohol once or twice, especially in moist climates.

After *all* the water has been withdrawn by the absolute alcohol, by remaining in it for three days to a week, the object is placed in turpentine, the best that can be procured. In this it is allowed to remain until it becomes thoroughly saturated—with large objects it is best to change the turpentine once. Two or three days are required for this stage. When saturated the object is quite stiff, and when the process is successful little or no contraction has taken place. The object is then placed in the air and protected carefully from the dust, and the turpentine allowed to evaporate. The object then soon presents a very beautiful appearance; it becomes white, resembling the whitest kid. It is light, stiff and, on account of the resin it contains, is perfectly insect-proof.

In annelides the iridescence is perfectly kept; hair and feathers retain their original colors.

If hollow organs, as the stomach, bladders, lungs, etc., are to be prepared, they may be blown up after they have been a short time in the turpentine; by so doing much space, and consequently much alcohol, are saved.

This is the practical part of the method, and I may add in a few words the whole principle. The object is to carefully and slowly harden the tissue and to *remove every particle of water*, the place of which is taken by the resin.

If the process be hurried contractions are apt to occur, and consequently bad-looking specimens result.

The *advantages* of this method are great. We have a perfectly dry object, with the perfect form kept; it is far preferable to handle than alcoholic dissections or preparations. It will last indefinitely and is insect-proof.

Prof. Semper keeps his preparations in glass boxes which are perfectly dust-proof, and by this both sides of the preparation can be distinctly seen.

An addition to this process was discovered by Prof. Semper about two years ago, which I do not think has yet been published. It is to place the prepared object in a solution of glycerine and sugar. In some objects this brings back almost entirely the original color of the animal; one disadvantage of this is, however,

that unless kept in dust-proof cases they would become spoiled by the dust collecting on them.

As absolute alcohol is so expensive in this country, the cost of a large specimen would be considerable, and therefore the process is better adapted for smaller objects.

A cheap method of making absolute alcohol, from the strong (95 per cent.) spirit, used in Prof. L. Rauvier's laboratory in Paris, would not, I think, be out of place to be mentioned here.

The details of this process were given me by my friend, Dr. W. Vignal, the assistant of Prof. Rauvier. A wide-mouthed bottle is taken, holding about a litre, and a three-quarters filled with the strong alcohol.

A mass of pulverized cupric sulphate ($CuSO_4$ + 5 Aq.) is heated to a red heat in order to drive off the water of crystallization. This is poured, when cool, into the alcohol, the mouth of the bottle quickly closed, and the whole shaken. The cupric sulphate is insoluble in alcohol, but has an affinity for the water contained in it, and the water is consequently taken up, and the cupric sulphate becomes bluish. When this has stood—with occasional shakings—for a day or so, decant, and repeat the operation, especially if there is very much of a blue color in the sediment.

When finished a drop of alcohol can be mixed with a drop of turpentine on an object-glass, and if there be no particles of water to be seen under the microscope, the alcohol is absolute enough for all practical purposes.

February 5.

The President, Dr. Leidy, in the chair.

Twenty-seven persons present.

The following papers were presented for publication:—

"Notes on a Collection of Anchovies from Havana and Key West, with an account of a new species, Stolephorus eurystole, from Wood's Holl, Mass.," by Jos. Swain and Seth E. Meek.

"On a new species of Rotifer, of the Genus Apsilus," by Sara Gwendolen Foulke.

The death of Wm. T. Haines, a member, was announced.

February 12.

Rev. H. C. McCook, D. D., in the chair.

Thirty persons present.

A paper entitled "List of Fishes from Egmont Key, Florida, in the museum of Yale College, with descriptions of two new species," by David S. Jordan, was presented for publication.

Fresh-water Sponges as improbable causes of the pollution of river-water.—Mr. Potts reported that on the 9th of February he had visited and partially examined the forebay at Fairmount Water-works, on the Schuylkill River, from which the water had been temporarily withdrawn, with a view to discover the winter condition of the fresh-water sponges and the other inhabitants of that locality. He found far the larger part of the wall surface below the water-line inaccessible on account of a thick deposit of mud upon the bottom, and much water remaining in the forebay. Wherever reached, however, and so far as the eye could detect in other places, it was covered by a mud-colored incrustation of considerable thickness, which a more minute examination showed to be composed almost wholly of the statoblasts and spicules of the sponge *Meyenia Leidyi.* Some few fragments of *Meyenia fluviatilis* and *Spongilla fragilis* were seen, but the first-named was clearly the prevailing species.

A sluiceway which formerly supplied the last of the old "breast wheels" used in pumping into the reservoir, but from which the water had been for many months excluded, was entered and examined. Here the remaining incrustation (much having doubtless crumbled and fallen away) was from one-fourth to one-half

an inch thick, of the appearance of crumbling plaster, and, as in the other cases, it consisted of the sponge before named, with but a small proportion of intruded material.

While considering the effect of the presence of so large a sponge-growth at the very inlet to the supply-pumps, Mr. Potts stated that this particular species was conspicuous among the known North American sponges by its great relative density and the small proportion of its sarcode or flesh. Its decay, therefore, at the termination of its period of summer growth would be a less cause of pollution to the water-supply than that of any other sponge

Moreover, from recent investigations into the life-history of these low organisms, he was inclined to believe that decay was not the normal or necessary result of the close of each season's growth. The fragile branches of some species inhabiting exposed situations may, of course, be broken off and destroyed while the sarcode still covers them; but in the sessile portions, and in all when sufficiently protected, the cells of the sarcode at the period of full maturity, forsaking their places along the lines of the skeleton framework, gather together by simultaneous amœboid movements into dense groups, where they are soon covered by a tough chitinous "coat," which, in time, generally becomes surrounded by a "crust" of minute granular cells, and armor-plated by a series of protective spicules. These groups are now recognized as the statoblasts, gemmules or winter-eggs of the sponge—eggs only in appearance—in reality the resting spores or protected germs which conserve the life of the individual through the cold and storms of winter, and awake very early in the springtime into new life—yet a continuance only of the same existence which was seen a few months before nestling into this winter's sleep.

If this is the ordinary course with these organisms there seems no reason to regard them as serious causes of the pollution of our streams, though violent freshets before this resting period is reached may tear them to pieces, and their decay may give a temporary taint to the water.

Continuing the narrative of his exploration, Mr. Potts described the iron pipes which had lain for many years upon the bottom of the fore-bay, as covered in some places to the depth of an inch or more, with a crust richly colored by iron-oxide, but principally composed, as were the others, of the spicules and statoblasts of *M. Leidyi*. Upon the surface of this crust in places, he found the remains of large colonies of *Urnatella gracilis* Leidy. In the absence of any positive knowledge of the winter condition of this curious polyp, Mr. Potts had examined with much interest a novel form of statoblast, which was frequent upon the same pieces of sponge; but he was unsuccessful in associating it with the polyzoan. It is most probable that the life is continued as suggested by Dr. Leidy, within the urn-like joints of this crea-

ture, and that they put out buds and a new growth in the spring. To discover if this be the case he had placed some fragments in water, and while awaiting results he had been surprised at the appearance within a few days amongst the fragments of *Urnatella*, of numbers of the recently described chætobranch-worm, *Manayunkia speciosa*, of Leidy, as well as several living cells of a species of *Paludicella*, probably *P. elongata*, of the same author. The persistence and tenacity of life in these apparently delicate creatures, overcoming not only the severity of a hard winter, but an exposure of several days in the open air, were further commented upon.

FEBRUARY 19.

The President, Dr. LEIDY, in the chair.

Thirty-seven members present.

The deaths of Dr. Geo. Engelmann and Prof. Arnold Guyot, correspondents, were announced.

Indian use of Apocynum cannabinum as a textile fibre.—At the meeting of the Botanical Section held on the 18th inst., Mr. THOMAS MEEHAN stated that while it was well known that the fibre of *Apocynum cannabinum* was used by the Eastern Indians in the manufacture of baskets, mats and other articles, he had heard it doubted whether the same plant was used by the Indians in the West. He had interested a lady in Washoe Valley, Western Nevada, to get direct from the Indians of that section stems of the plant used by them. She had done so, and he now exhibited them. They proved to be the same plant, *Apocynum cannabinum.*

The Longevity of Trees.—Professor Sheafer, of Pottsville, Pa., reading an abstract of MR. MEEHAN's remarks, in Proceedings of the Academy, had cut and sent for the inspection of members some specimens from Schuylkill county, remarkable for slow growth, of a black oak, *Quercus tinctoria*, in which the annual growths showed in a little over two inches from the centre an average of 36 circles to an inch; one of hemlock spruce, *Abies Canadensis*, 51 to an inch; and one of the common chestnut, *Castanea vesca Americana*, 24 to an inch. Though only four inches in diameter, the oak stem was seventy-six years old; the hemlock one hundred and four years and in diameter four inches; and the chestnut four and a half inches in diameter in sixty years.

With a struggle for life either from poverty of the soil, elevation, or close growth of trees, which the small annual growths

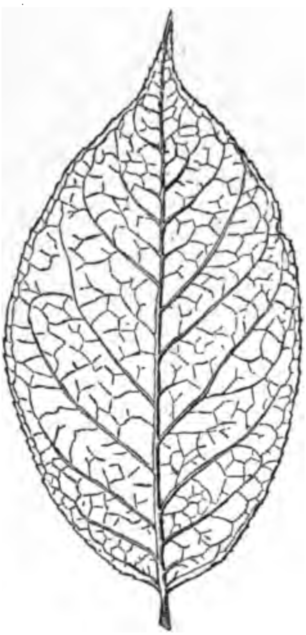
indicated, Mr. Meehan believed the atmospheric conditions, as regards shelter from wind or from drying atmospheric currents, must be very favorable to induce longevity under such circumstances. There seemed to be no reason why these trees might not reach the full average duration of two hundred years, which he had before named as about the duration of most trees of the Eastern United States.

Prof. Sheafer gave some instances indicating that the average might be higher than the figures he had offered.

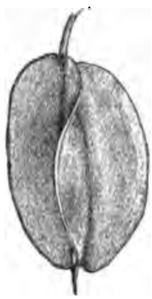
Parasitism in Boschniakia glabra, E. Meyer.—Mr. MEEHAN exhibited a specimen of this Orobanchiaceous plant collected by him last summer, growing among alders in the track of the retreating Davidson Glacier, near Pyramid Harbor, lat. 59°, in Alaska, and remarked that the life-histories of this class of parasitic plants were but imperfectly known, and every new fact of interest. In the Yosemite Valley last year, with Mr. John M. Hutchings and Dr. Charles Shäffer, of the Academy, they had carefully dug out masses of earth with the snow plant of the Sierras, *Sarcodes sanguinea*, and then tenderly washed out every particle of earth in a stream near by. There was not the slightest sign of attachment to any root, and no root of anything to be found in the mass of earth. There were not even the slightest remains of any dead vegetation which could suggest that the plant was even a saprophyte, as was generally found in the case of *Monotropa uniflora*. There was nothing but a huge mass of coralline fleshy matter, out of which the inflorescence rose. The origin of this fleshy mass was yet the unsolved mystery. From analogy with the behavior of other plants, he was inclined to believe that there was some parasitic attachment in the early life of the plant, and that it stored up in this coralline mass enough nutrition in one season to support the inflorescence of another, and, after this was done, severed the connection, leaving no trace by the time the mass was large enough to support the heavy drain of the large and juicy inflorescence. In *Boschniakia*, something of this sort had evidently taken place. The plants were in an early flowering stage, and all, when drawn out of the ground, had a single thread-like root depending from the centre of the pseudo-bulbous base of the plant, as in the specimen exhibited. These threads, now hard and wood-like, broke off very easily at the time, and it did not occur to the collector that they might be alder roots, as the density of the substance might now suggest. The desire to botanize over as large a tract as possible in the six hours given by the commander of the ship, did not admit of time to dig down and ascertain directly whether these threads were alder roots, and in direct connection with the living alder plants; but it would be remarkable, if they should be alder roots, and the *Boschniakia* sessile on them, that the plants should all select roots of the same slender size, and so nearly

exactly alike as the twelve or eighteen specimens examined in this way indicated. Mr. Meehan stated that he had, in his *Flowers and Ferns of the United States*, series ii, vol. ii, p. 95, noted the existence of a similar thready attachment at the base of *Epiphegus Virginiana*, evidently connecting the plant with a foster-parent in early life—a fact since confirmed by Mr. Fergus, of West Chester, Pa.; and a fuller examination of these cases might afford the clue to all.

Variation in Halesia.—Mr. MEEHAN exhibited dry leaves and fruit of *Halesia diptera*, *H. tetraptera*, and of a remarkable departure raised from the last-named species some years ago. This appeared in a bed of seedlings all raised from seed gathered from one tree growing in a garden in Germantown. It attracted attention when one year old by the leaves bearing a resemblance to those of an apple-tree. The parent tree had leaves narrowly lanceolate and acuminate, rather thin, pale green on the upper surface, and with no particularly prominent veins. The plant in question had broadly ovate leaves, scarcely pointed, very dark green and rugose on the upper surface, and strongly veined and hirsute below. It was planted to see what it would come to.



1. *H. tetraptera.*

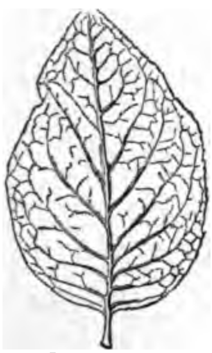


1*a*. *H. tetraptera.*

The flowers were open cup-shaped, instead of being drawn into a narrow tube at the base, as in the parent plant and the pistil was wholly enclosed and not exserted. For several years the plant was sterile, and many good botanists, whose attention was called to it, regarded the plant as a hybrid, and the sterility as a proof thereof. It seemed of no avail to point out that there was no other species with which the parent could have obtained pollen within many miles, nor to show that hybrids were not necessarily sterile. This season the plant produced fruit for the first time, some of which were now exhibited to the Academy. They are very small, not much over a quarter of an inch in diameter, and the four equal wings were comparatively large and of a strongly coriaceous character. The fruit which had been cut

open were found to have perfect seeds. If the plant with these leaves, flowers and fruit had been found in a state of nature, the botanist would surely have made a new species of it, if indeed he would not have had some doubts of a new genus.

Mr. Meehan then referred to his contributions in the past, tending to show that there was an innate tendency in plants to vary; that this natural tendency was at the foundation of all theories of evolution, and that environment had not near the influence on variation some good botanists claimed for it. If we were to take environment as a serious element of change, there would be no certainty in the direction of change; but a glance at the palæontological and other evidences showed that change had been always in the direction of certain uniform lines, and evidently in accord with a predetermined plan, which the accidents of environment had not been able to override. At any rate, such illustrations as this of the *Halesia* showed a remarkable change with which certainly environment had nothing to do. The seeds were all from one tree, with not even another individual of its own species near it. The seedlings all came up in one bed together, and yet out of many hundred seedlings, all with the same exact conditions of environment, there was not one with even an approach to the singular peculiarities of this.



2. *H. tetraptera*, var.

2 a. *H. tetraptera*, var.

In regard to the sterility or fertility of plants, what we would call environment had evidently much to do, and this also he had endeavored to point out in former botanical contributions. In his paper before the American Association for the Advancement of Science, at Detroit, in 1875, he had shown that Mr. Darwin's experiments in keeping bees from clover, and which in England led to sterility, did not so prove in Philadelphia, the protected plants there being fertile; and he there made the suggestion that the different conditions of environment led to the different results. He had also since then shown that *Linum perenne* in Philadelphia was self-fertile, though in England Mr. Darwin had found that one might as well apply so much inorganic dust to a pistil as the flower's own pollen. Here we have another illustration. The exuberance of vegetative growth being checked by age, or some other circumstance of climate or season, acting against the vegetative and in favor of the reproductive principles—principles we know by many illustrations were antagonistic—gave us this season an environment for the first time favorable to fertility.

The figures are two-thirds the actual size.

The following were ordered to be published:—

NOTES ON A COLLECTION OF ANCHOVIES FROM HAVANA AND KEY WEST, WITH AN ACCOUNT OF A NEW SPECIES (STOLEPHORUS EURYSTOLE) FROM WOOD'S HOLL, MASS.

BY JOSEPH SWAIN AND SETH E. MEEK.

The present paper is based on a large collection of Anchovies, made by Professor Jordan at Havana, Cuba, and at Key West, Fla. We recognize two species of *Stolephorus* in this collection from Havana. Both of these species occur in the collection from Key West, as also *Stolephorus miarchus*, a species hitherto recorded only from Mazatlan and Panama on the Pacific Coast.

We are indebted to Professor Jordan for the use of his library and for valuable suggestions.

1. **Stolephorus perfasciatus** (Poey) Swain and Meek.

Engraulis perfasciatus Poey, Memorias Cuba, ii, 313, 1858 (Havana); Poey, Syn. Pisc. Cuba, 421, 1868 (Havana) (not of Poey, Synopsis, p. 460); Günther, Cat. Fishes Brit. Mus., vii, 391 (Cuba) (not of Swain, Bull. U. S. Fish Comm., 1882, 55, nor of Jor. and Gilb., Syn. Fish. N. A., 273).

Head 4 to $4\frac{1}{2}$ in length to base of caudal. Depth $5\frac{3}{4}$ to $6\frac{1}{2}$. Dorsal 12 to 13. Anal 14 to 16.

Body oblong, somewhat compressed. Snout shorter than eye, compressed and pointed. Top of head with a slight keel. Eye about $3\frac{1}{2}$ in head. Mouth slightly oblique. Maxillary and lower jaw finely toothed. The posterior end of maxillary rounded, not extending quite to margin of preopercle. Gill-rakers numerous, rather weak and toothed on under side, the longest about $1\frac{1}{3}$ in eye. Pectoral fins about $1\frac{3}{4}$ in head, their tips not reaching ventrals by about diameter of eye. Ventrals short, their tips not reaching anal by length of fin. Caudal forked. Origin of anal below last ray of dorsal. Origin of dorsal midway between root of caudal and pupil. Scales deciduous. Color as in *Stolephorus browni*, without dark punctulations except on base of caudal and often on base of anal. Sides with a well-defined silvery band, its width about $\frac{3}{4}$ eye, being rather narrower than usual in *S. browni*.

This description is taken from numerous well-preserved specimens, about $2\frac{1}{4}$ inches in length, obtained by Prof. Jordan with

a seine at Key West. Five specimens, the largest about 3 inches in length, were also obtained at Havana.

Stolephorus perfasciatus Jordan and Gilbert, Syn. Fishes North America, p. 273, and Swain, Bull. U. S. Fish Comm., 1882, p. 55, is a different species, apparently without a name. It differs chiefly in a greater number of anal rays, and in having a wider and less silvery lateral band. No specimen of the true *perfasciatus* is known to reach the size of the specimen from Wood's Holl, Mass. This species from Wood's Holl may stand as *Stolephorus eurystole* Swain and Meek. Specimens of this species, perhaps mixed with others, have been distributed by the U. S. National Museum under the following numbers, 19,003 to 19.017. The one originally described by Mr. Swain and by Jordan and Gilbert was destroyed in the burning of the Museum of the Indiana University, but others like it exist in the U. S. National Museum.

2. **Stolephorus browni** (Gmelin) Jordan and Gilbert.

This species is by far the most common of the Anchovies, both at Key West and Havana. For synonymy and description see Swain, Bull. U. S. Fish Comm., 1882, 56. *Engraulis perfasciatus* Poey, Syn. Pisc. Cuba, 1868, 460, is apparently not a true *perfasciatus*, and is probably this species.

3. **Stolephorus miarchus** Jordan and Gilbert.

Stolephorus miarchus Jordan and Gilbert, Proceed. U. S. Nat. Mus., 1881, 334 (Mazatlan).

Four specimens from Key West. We are unable to detect any discrepancy between these specimens and the descriptions published by Jordan and Gilbert of the types of this species from Mazatlan.

4. **Cetengraulis brevis** (Poey) Swain and Meek.

Engraulis brevis Poey, Repert. Fis. Nat. Cuba, i, 379, 1866 (Cuba); Poey, Syn. Pisc. Cuba, 422, 1868 (Cuba); Günther, Cat. Fishes Brit. Mus., vii, 383, 1868 (no specimen).

Head in length to base of caudal, $3\frac{1}{2}$ ($4\frac{1}{8}$ in total); greatest depth 3 ($3\frac{3}{5}$); about 40 scales in lateral line, and 11 scales in a transverse series beginning at origin of anal fin. Anal 23 to 25. Dorsal 15.

Body deep, compressed; belly compressed, not serrate. Head rather short. Snout short and sharply pointed, $1\frac{2}{3}$ in eye, which

equals the width of interorbital area and is contained 4 times in the length of head.

Mouth somewhat oblique; mandible extending little in front of anterior part of orbit. Maxillary slender, very finely toothed on posterior two-thirds only, not quite reaching root of mandible. Lower jaw toothless. Gill-rakers close-set, longer than diameter of eye, $3\frac{1}{2}$ in head. Cheeks triangular, longer than high.

Scales rather firm, not caducous. Pectoral fin not reaching base of ventral, 2 in head. Ventrals short, 3 in head. Caudal deeply forked, minutely scaled, $1\frac{1}{2}$ in head. Base of anal contained $1\frac{2}{5}$ times in head. Dorsal and anal fins with dense basal sheaths, which entirely hide the fin when depressed.

Color in spirits plain silvery on sides, darker above. A dark band beneath the scales about as broad as eye, extending from upper angle of opercle to caudal.

This description is based on specimens about $4\frac{1}{2}$ inches in length, obtained by Prof. Jordan in the Havana Market.

ON A NEW SPECIES OF ROTIFER, OF THE GENUS APSILUS.

BY SARA GWENDOLEN FOULKE.

Among *Spirogyra* and *Anacharis*, gathered in Fairmount Park, were noticed numbers of large rotifers, attached to filaments and leaves of the plants. Though resembling in some respects the forms, *Dictyophora*, of Leidy; *Apsilus*, of Meczinchow, and *Cupelopagus*, of Forbes, this rotifer still possesses sufficiently striking differences to warrant its being regarded as a distinct species. The size of the specimens examined varied greatly, the maximum size being one-fiftieth of an inch, from the top of the extended net to the end of the body.

The ventral outline of the body is ovoid; the lateral outline is crescent-shaped; while the dorsal outline is similar to the ventral. Instead of rotatory organs, this rotifer possesses a membraneous cup or net, near the base of which, on the ventral side, are two lateral antennæ, as in *Apsilus lentiformis*.

When the net is retracted, the antennæ are also withdrawn into the body, and concealed from view. This is an unusual habit among the Rotatoria, the antennæ being usually situated upon the body, and remaining exposed so as to act as sentinels when the rotatory organs are retracted. This net is used for the capture of food, consisting of the larger infusoria closing over any organism which is attracted into it. After capture, the food passes through the oral aperture into a large, sac-like passage-way, and thence into a second pouch, which extends across the body in the form of a much-wrinkled bag. The two ends of this bag widen into sacculated pouches, which are used as storehouses for the food while softening. This organ may be regarded as the stomach proper, being filled with a greenish granular fluid, which performs the office of a true gastric juice, softening the tissues of the contained food, in preparation for the action of the mastax. When this maceration has been sufficiently prolonged, the food is forced, by muscular contraction, out of its recess, along the narrow central portion, past the mastax and into the opposite pouch. As the stream of food passes, the mastax, which is situated centrally at the bottom of the stomach, turns, so as to face the stream of mingled food and gastric fluid; and works actively, chopping and bruising such portions as come

within reach. The mastax exactly resembles that of the three other known species, being composed of two curved major unci, near the base of each of which are situated four minor unci. After being acted upon by the mastax, the food passes between the unci into the œsophagus whence it is absorbed or thrown off by the system. The ventral view of these organs is usually obscured by large numbers of embryo, in various stages of development. In front of the digestive sac, and apparently connected with it, are two curved, pear-shaped sacs, of a transparent greenish hue.

This rotifer, in common with all members of its genus, has an unarticulated body, which is incapable of contraction.

The net, which takes the place of rotatory organs, is shaped like a hood, the ventral portion being elevated into an obtuse lobe. In order to strengthen and support the long, curved, dorsal outline of the net, there is, covering about two-thirds of it, a membraneous shield, made doubly strong by two wide, arched, muscular bands running around it. At the base of this shield is a pointed projection, which is of still firmer composition. The necessity for such an arrangement is obvious, when it is remembered that the normal position of the animal is a semi-recumbent one; so that the weight of the net, which is about three-quarters the area of the body, would be very considerable at these carefully strengthened points.

The whole muscular system of this species is strongly marked and powerful. Focussing downwards from the outside of the dorsal view of the net, two gradually narrowing ridges or flaps are seen extending up the inside of the hood. These flaps are fringed with quite long cilia, and there are also shorter diagonal lines of more minute cilia, the exact number of which lines could not be accurately determined. This is the first instance in which cilia have been discovered in any member of the genus, all those species previously described, being stated to be *totally destitute* of these organs. In this case, their presence was first detected while focussing through the dorsal side of the net, although they could afterwards be plainly seen in a ventral view. It was only by careful placing of the mirror that the cilia were visible.

Attached to the inside walls of the rotifer were the enigmatical transparent bodies common in the Rotatoria; and also a number

of purplish brown bodies, varying in intensity of tint, whose character is as yet unknown.

The rotifer, in the adult state, is tailless, eyeless, and attached in a semi-recumbent position, from which it is incapable of detaching itself, and without the power of re-attaching itself when displaced.

In the young state it has two red eye-spots; a clumsy telescopic tail, terminating in a broad, cup-shaped sucker; and is so actively free swimming that no accurate drawing could be obtained. In this undeveloped state the rudimentary net is a thick fleshy triangle, the truncated apex of which is inserted into the body, while the base is surrounded by a wreath of cilia, on the closed space within which the eye-spots are set. There is in this stage no opening to admit nourishment.

The development of this form into that of the very dissimilar adult state is most interesting, and well worth the time and patience necessary to observe it.

It is proposed to unite the three forms, *Dictyophora vorax*, *Apsilus lentiformis*, *Cupelopagus bucinedax*, and the form described above, in one genus under the name *Apsilus*. The name *Dictyophora* would have the first claim for adoption, but it is already in use in two other branches of science, so that the choice must fall upon the next in order of priority. The specific names given to the forms by their discoverers are retained. The history of the genus is as follows: In 1857, Dr. Jos. Leidy discovered and described a form which he named *Dictyophora vorax*. In 1866, Meczinchow described and named a similar form which he named *Apsilus lentiformis*, the differences from *Dictyophora* being as follows: shape of the cup; presence of two lateral antennæ; and presence of a conspicuous ganglion of the pouch.

In 1882, S. A. Forbes described a form which he named *Cupelopagus bucinedax*, designating it as a new genus. The differences between this and the two forms previously described are as follows: *Cupelopagus* differs from *Dictyophora* in the shape of the net, and in the general shape of the body, the difference in these particulars being very marked. It differs from *Apsilus* in the absence of the ganglion of the pouch, in the absence of the lateral antennæ, and in other minor particulars.

The species described by the author varies from the foregoing in the following respects: it differs from *Dictyophora* in the

shape of the cup, as well as that of the body; in the presence of two lateral antennæ; in the possession of a second crop or stomach situated below the ordinary crop; in the marked muscular system, and in the ciliation of the net.

The points of dissimilarity between this form and *Apsilus* are as follows: The shape of the cup; the absence of the ganglion; the presence of a second stomach, and in the ciliation of the cup. It differs from *Cupelopagus*: in the shape of the cup; in the construction of the cup; in the two lateral antennæ; in the presence of a secondary stomach; and in the ciliation of the net.

The presence of the secondary stomach distinguishes this species from the rest of the genus. The presence of cilia is not so certain a distinction, as by dexterous management of illumination their presence might possibly be detected in some other of the species.

From the presence of the secondary stomach or pouch, it is proposed to name this new species *Apsilus bipera*—*pera* meaning "a little pouch to carry food."

The reasons for uniting the three forms heretofore considered separate genera, are, of course, founded on the strong points of resemblance; these being, briefly, the presence of two eye-spots, of a membraneous cup, of a mastax exactly similar in all four forms, of the absence of tail or footstalk, of the absence of carapace, and of the similar habits.

The characteristics heretofore used in the classification of the Rotatoria, as denoting members of the same genus, are: character of rotatory organs; number of eye-spots; absence or presence of carapace, and habits.

In selecting the name for this new division, *Dictyophora*, of Leidy, has the right of priority, but, owing to its having been already many years in use, in two other branches of science, the choice must fall upon that next in order of priority, which is *Apsilus*, of Meczinchow.

The genus *Apsilus*, then, will consist of four species—*Apsilus vorax* Leidy; *Apsilus lentiformis* Meczinchow; *Apsilus bucinedax* Forbes; and *Apsilus bipera* Foulke.

As there is no family in the class Rotatoria, in which the above genus may be placed, a new family, to be named *Apsilidæ*, is pro-

posed; characteristic, the substitution of a membraneous cup or net, destitute of external ciliation, in the place of the ordinary rotatory organs.

Bibliog.—Leidy, *Proc. Acad. Nat. Sci.*, 1857, 204; Meczinchow, *Zeits. f. wis. Zoologie*, 1866, 346, *Taf. XIX;* Forbes, *Am. Month. Micros. Jour.*, 1882, 102, 151.

REFERENCES TO PLATE I.

FIG. 1. *Apsilus vorax* (*Dictyophora vorax* of Leidy). *a.* Membraneous net. *b.* Crop. *c, c.* Embryo. *d.* Mastax. *e.* Œsophagus. *f.* Oral aperture. *g.* Vent. *h.* Muscular system of net. *Reduced from drawing by Leidy. The body is slightly wider in proportion to the net than in original drawing.*

FIG. 2. *Apsilus lentiformis* Meczinchow. *a, a.* Antennæ. *b.* Muscular system of net. *c.* Crop. *d.* Mastax. *e, e.* Embryo. *f.* Œsophagus. *g.* Purplish brown bodies. *Reduced from drawing by Meczinchow.*

FIG. 3. *Apsilus bucinedax* (*Cupelopagus bucinedax* of Forbes). *a.* Net. *b.* Oral aperture. *c.* Crop. *d.* Mastax. *e, e.* Embryo. *f.* Œsophagus. *Reduced from drawing by Forbes.*

FIG. 4. *Apsilus bipera* Foulke. *a, a.* Antennæ. *b.* Muscular system of net. *c.* Oral aperture. *d.* Crop. *e.* Secondary sacculated stomach. *f.* Mastax. *g.* Œsophagus. *h, h.* Embryo. *i.* Enigmatical purplish brown bodies attached to walls of body.

FIG. 5. *Apsilus lentiformis* Meczinchow. *a, a.* Ganglion of the pouch. Superficial view when closed.

FIG. 6. Dorsal view of net of *Apsilus lentiformis*. *a, a, a, a.* Muscular system.

FIG. 7. Dorsal view of net of *Apsilus bipera*. *a.* Shield. *b.* Pointed support. *c.* Portion of net above shield. *d.* Muscular system of shield. *e.* Ciliated flaps extending up inside of net.

LIST OF FISHES FROM EGMONT KEY, FLORIDA, IN THE MUSEUM OF YALE COLLEGE, WITH DESCRIPTION OF TWO NEW SPECIES.

BY DAVID S. JORDAN.

A small collection of fishes from Egmont Key, in Tampa Bay, Southern Florida, belonging to the Museum of Yale College, has been sent to me for identification by Professor A. E. Verrill. The fishes were collected some years ago, a part by Mr. William F. Coons, the remainder by Mr. E. Jewett. In the following list the species collected by Mr. Jewett are marked with the initial "J". Those not thus marked were obtained by Mr. Coons. The numbers given are those on the register of the Museum of Yale College. Those marked with a star (*) have been presented to the Museum of Indiana University.

1. **Rhinobatus lentiginosus** Garman. (805, 821*.)

An adult specimen and a fœtus.

2. **Opisthonema oglinum** (Le Sueur) Bean. (809.)

(*Opisthonema thrissa* Auct., not *Clupea thrissa* L.)

The original type of *Clupea thrissa* L. was a fish brought from China by Lagerstrom and described by Linnæus' pupil Odhel, in the Amœn. Academ., v, 251, under the name (prebinomial) of *Clupea thryza.* Lagerstrom's fish was a species of *Dorosoma.* The *Clupea thrissa* of Osbeck was also a *Dorosoma.* In the synonymy given by Linnæus, of *Clupea thrissa*, in the tenth edition of the Systema Naturæ, are included, among others, some references to our *Opisthonema.* In this twelfth edition of the same work is a description of a *Clupea thrissa* received from Dr. Garden of Charleston. This "*thrissa*" is *Dorosoma cepedianum.* The species called *Clupea thrissa* by Broussonet, Cuvier and most later authors, is our *Opisthonema*, but the specific name *thrissa* can be properly used only for the Chinese *Dorosoma*, for which it was at first intended. The oldest name belonging to our species (as already noted by Dr. Bean, Mss.) is that of *Megalops oglina* Le Sueur.

3. **Sidera ocellata** (Agassiz) J. and G. (804; 824* [J]; 840.)

4. **Cœcula scuticaris** (Goode and Bean) J. and G. (800*; 801.)

Head $9\frac{1}{2}$ in distance to vent; trunk very slightly shorter than tail; cleft of mouth $3\frac{1}{2}$ in head, in a specimen $16\frac{1}{2}$ inches long.

Pectorals very minute. This specimen agrees equally well with the description of *Cœcula scuticaris* and *Cœcula teres*, nor is it evident, from the published accounts, how the two are to be distinguished from each other.

5. **Cœcula bascanium** sp. nov. (826 [J.].)

This species belongs to the same group as *Cœcula scuticaris* and *C. teres*, but is distinguished from either by the shorter head and better developed pectoral fin. The type is 31 inches long, in fair condition.

Body extremely slender, subterete, its greatest depth little more than two-fifths length of head; head short; snout short, 7 times in head; mouth very small; lower jaw thin, included, not extending forward to the anterior nostril, which is in a short tube; teeth short, subconic, bluntish, a little unequal; their points directed backward; lower teeth nearly in one series; upper teeth uniserial laterally, partly biserial anteriorly; vomerine teeth in a rhombic patch, some of them a little enlarged. Eye moderate, its length rather more than half snout, its centre scarcely behind middle of upper jaw. Cleft of mouth $3\frac{3}{4}$ in length of head. Gill-opening vertical, about as wide as isthmus, its upper edge about on level of upper edge of pectoral; pectoral small, but larger than in related species, a little broader than long and about as long as snout. Dorsal fin very low, beginning at a point about midway between front of eye and gill-opening; anal similar to dorsal. Head $11\frac{1}{2}$ times in distance from snout to vent. Trunk a little longer than tail. Total length 31 inches; head $1\frac{2}{5}$ inches; trunk $14\frac{4}{5}$; tail $14\frac{1}{2}$. Color in spirits, dark-brown, nearly or quite uniform; fins paler.

6. **Ophichthys intertinctus** (Richardson) Günther. (803*; 825 [J].)

Dark brown above, paler below; sides and back with about three rows of large, ovate, brown spots, somewhat irregular in size and position, those of the upper row smallest, the large and small ones of the lower row somewhat alternating; spots on head small and numerous. Dorsal with an interrupted dark margin; anal with a darker edge; pectorals blackish. Head $3\frac{1}{2}$ in trunk; cleft of mouth nearly half length of head; pectoral about 5 in head. Dorsal commencing a little behind end of pectoral. Tail rather longer than rest of body. The dentition is well described by Dr. Günther (viii, 57).

Two large specimens. This species has not been previously recorded from the waters of the United States.

7. **Myrophis egmontis** sp. nov. (802; 827* [J.].)

Two specimens in fair condition.

Head small, slender, moderately pointed; anterior nostril in a short tube; posterior nostril large, with a raised rim, placed directly behind the anterior; cleft of mouth rather short, extending to beyond the rather large eye, which is more than half the length of the snout; cleft of mouth $3\frac{1}{8}$ in head; teeth in both jaws subequal, pointed, slightly compressed, arranged in single series, those of both jaws directed backward, the lower teeth being more oblique than the upper; upper jaw with about 4 small fixed canines. No teeth on vomer in either of the typical specimens. Tongue not free. Lower jaw considerably shorter than upper, its edge considerably curved, concave in profile. Nape somewhat elevated. Top of head with large pores.

Head $5\frac{1}{2}$ times in distance from snout to vent; head and trunk a little shorter than tail. Body slender, its greatest depth a little more than length of gape. Pectoral fin short and broad, slightly longer than snout; gill-opening short, oblique, extending downward and backward from near the middle of the base of the pectoral. Dorsal fin beginning behind vent, in one specimen at a distance about equal to length of gape; in the other specimen, a little farther forward; dorsal fin very low in front, becoming gradually higher toward the tip of tail; anal fin low, but well developed, considerably higher than dorsal, highest anteriorly, uniting with the dorsal around the tail.

Color in spirits, dark-brown, apparently uniform, somewhat paler below.

Length of specimen about 15 inches.

We refer this species to *Myrophis*, although its dorsal is inserted very much farther back than in any of the known species of that genus. The absence of vomerine teeth, if normal, still farther separates it from the other species, and it is not unlikely that it should be regarded as the type of a distinct genus.

One of the types (827) has been presented to the U. S. National Museum.

8. **Siphostoma affine** (Günther) Jordan [illegible]

9. **Stromateus alepidotus** L. Jor. and Gilb. [illegible]

The adoption of the earlier name, *Stromateus paru* L., for this species is perhaps premature, until West Indian specimens are examined.

10. **Trachynotus carolinus** L. [illegible]

11. **Lutjanus campechianus** Poey [illegible]

12. **Chætodipterus faber** Broussonet [illegible]

13. **Batrachus pardus** Goode and Bean [illegible]

One specimen, with the typical coloration of this form.

14. **Gobiesox virgatulus** Jordan and Gilbert [illegible]

Three specimens; the largest rather more than three inches long, thus much larger than the original types. Caudal dusky; a dusky blotch on front of dorsal. D. 11, A. 8. Eyes very small, barely one-fourth interorbital width. Head 3, its width 2½. Lower teeth moderate, entire; upper bluntish, in two or three rows, two of the outer a little enlarged. This is probably identical with *Gobiesox nudus* Günther, but it cannot be the original *Cyclopterus nudus* of L.

15. **Scorpæna stearnsi** Goode and Bean [illegible]

16. **Achirus brachialis** Bean [illegible]

A very young example, brown with a few irregular large whitish spots.

17. **Aphoristia plagiusa** (L.) Jor. and Gilb. [illegible]

A very young specimen.

19. **Malthe vespertilio** L. [illegible]

A short-nosed individual of the type which has been called *Malthe cubifrons* Rich. and *Lophius radiatus* Mitchill.

20. **Antennarius ocellatus** [illegible]

Pescador Parra, Peces de Cuba, Pl. 1, 1787.

Lophius vespertilio, var. *d. ocellatus* Bloch and Schneider, Ichth., 1801, 142.

Antennarius pleurophthalmus Gill, Proc. Ac. Nat. Sci. Phila., 1863, 92.

Color in spirits, brown, pale on the head and belly, darker posteriorly; anterior region covered with small, sharply defined black spots, the spots posteriorly larger, and more vague in outline, some of them diffuse shades. fins spotted like the body, vertical fins with some paler spots also, and a pale edge,

sides of body also with irregular gray leprous blotches (perhaps pink in life), the largest between last dorsal spine and first dorsal ray, forming a saddle; numerous smaller areas below this to base of pectoral; some on head; a small saddle between second and third dorsal spines; a large ring of the same grayish color, behind dorsal, forming a ring about caudal peduncle; some other blotches between soft dorsal and anal; a ring of black dots about eye; a large oblong black spot on middle of base of soft dorsal, surrounded by a light brownish ring; a similar ocellus below and a little before this on side of body, and a third on caudal fin a little before and above its centre; a few whitish dermal flaps on soft dorsal; inside of mouth black, with broad whitish longitudinal stripes, these most distinct on the tongue. Third dorsal spine much longer than second, its length equal to its distance from tip of snout; length of maxillary $4\frac{1}{3}$ in body. Upper part of head with some coarse, four-rooted stellar tubercles.

Our specimens agree very closely with the description of Dr. Gill. There can, however, be little doubt of their identity with with the *Pescador* of Parra, on which the *Lophius ocellatus* of Bloch and Schneider was based. The characteristic position of the ocellated spots is precisely the same in the two. I therefore adopt for it the name *ocellatus*. It is not improbable that *Antennarius annulatus* Gill, from Garden Key, will be found identical with *A. multiocellatus* (Cuv. and Val.).

20. **Balistes carolinensis** Gmelin. (805.)

21. **Alutera schœpfi** (Walbaum) Goode and Bean. (834.)

22. **Diodon liturosus** Shaw. (815.)

A young specimen, apparently corresponding to Dr. Günther's var. *a*, of *Diodon maculatus*.

FEBRUARY 26.

The President, Dr. LEIDY, in the chair.

Twenty persons present.

The following were presented for publication:—

"On an Ammonite from the Carboniferous formation of Texas," by Prof. Angelo Heilprin.

"The Tertiary Geology of Eastern and Southern United States," by Prof. Angelo Heilprin.

Messrs. Geo. W. Fiss and Francis E. Emory were elected members.

Distoma and Filariæ.—Prof. LEIDY directed attention to some parasitic worms presented this evening. Some of these were supposed to be leeches from the mouth of the alligator. Herodotus states that the crocodile of the Nile has the inside of its mouth always beset with leeches. The existence of the leech has been confirmed, and is known as the *Bdella nilotica.* The present specimens, however, do not belong to a leech, but pertain to a species of *Distoma*, apparently not previously described. It may be named and be distinguished by the characters as follows:—

DISTOMA ORICOLA. Body elongated elliptical, moderately wider and thicker posteriorly, and ending in a blunt, angular extremity, convex dorsally and flat ventrally, unarmed, smooth or minutely wrinkled transversely. Mouth subterminal, and enclosed with a reniform lip succeeded by a linear annulus. Acetabulum large, globular, included at the anterior fourth of the body, and opening ventrally by a conspicuous central aperture. Generative orifice ventral, at the posterior fourth of the body. Length, 15 to 20 mm.; breadth, 3 mm. Eight specimens obtained from the mouth of the alligator, *A. mississippiensis*, in Florida, by Mr. Stuart Wood.

Accompanying the specimens is a fragment of the tongue marked with circular scars, apparently due to the worms. The alcoholic specimens in their present condition are incurved, with the lateral margins inverted, and the included acetabulum produces a conspicuous dorsal eminence.

Of several Filariæ exhibited, two, a female and a male, pertain to the species *Filaria horrida*, Diesing. The former is 28 inches long, the latter 11 inches. They were obtained by Dr. Henry C. Chapman, from the thorax of the American ostrich, *Rhea americana.* The other specimens were obtained by Mr. P. L. Jouy, from the abdomen of *Strix brachyotus.* They consist of four females from 12 to 14 inches long and a half a line thick, and two males 2½ inches long and one-fourth of a line thick.

They are thicker anteriorly with the head end obtusely rounded, and with the mouth minute and bounded by a minute pair of conical lips. The tail end of the female is straight and blunt; that of the male is more tapering, and is included in an elliptical alary appendage, supported on each side by a row of five curving ribs. A pair of similar, but shorter and straight papillæ is situated near the anal aperture; and a pair of pointed processes diverge from the end of the tail into the alary expanse.

Two species of Filaria have been previously observed in *Strix brachyotus*, *F. attenuata* Rud., and *F. foveata* Schn., to neither of which the specimens under examination appear to belong. These, however, so closely accord with the descriptions of *F. labiata* Creplin, from the black stork, *Ciconia nigra*, that, notwithstanding the remote relationship in the host, the speaker believed them to belong to that species. In the construction of the caudal extremity of the male, they closely approximate the condition of *F. labiata* and *F. horrida*, as represented in the figures of Schneider (Monographie der Nematoden), while they are widely different from that of *F. attenuata* and *F. foveata*, as represented in similar figures of the same work.

Some notes on Manayunkia speciosa.—Prof. H. Carvill Lewis read a communication from Miss. S. G. Foulke, in which the following statements were made:—

In the worm *Manayunkia speciosa*, described and figured by Prof. Leidy (Proc. Acad. Nat. Sci. Phila., 1883), the tentacular crown, or branchial organ, is the feature of special interest.

According to Dr. Leidy, the tentacles present in an adult are eighteen in number, besides two larger and longer tentacles situated midway between the two lophophores. These larger tentacles are conspicuous by their bright green color, and are, in fact, external continuations of the blood-vessels extending lengthwise throughout the body. In shape, these tentacles taper from base to apex, are convex on the outside, but concave on the side which faces the centre of the tentacular crown; so that a transverse section would present the shape of a crescent. The two edges thus formed are fringed with cilia. When closely watched, the green tentacles are seen to pulsate with a rhythmical motion, contracting and expanding longitudinally. The pulsation takes place in each tentacle alternately.

At the moment of contraction the tentacle turns slightly on its axis, outwards and towards the end of the lophophore on that side, at the same time giving a backward jerk, returning to its former position at the moment of expansion.

By force of the contraction, the green blood filling the tentacle is forced downwards out of the tentacle, and flows along the blood-vessel on that side of the body. On the expanding of the tentacle, the blood instantly returns and suffuses it, and thus the process goes on.

The contraction and expansion occur at exact intervals, together occupying the space of two seconds. It is in this way that the blood is purified and its circulation controlled. These observations were made with a seven-eighths inch objective.

To ascertain how long the cilia upon the tentacles would continue their motion after separation from the body of the worm, both lophophores of an adult were cut off above their junction.

At first the tentacles remained closed from the shock, but soon they were expanded, the cilia displaying active motion, and presently the two separated lophophores began to move about in the zoophyte-trough. This motion was produced by the action of the tentacles, which bent in all directions, the tips touching the glass, and was not a result of the currents produced by the cilia. In a few minutes one lophophore had *crawled* in this manner quite across the trough, while the other remained floating in the water near its first position. In the case of this latter the motion was produced by the ciliary currents, and was entirely distinct from the *crawling* above noted.

During this time the decapitated worm had sunk to the bottom, and, though turning and twisting a good deal, did not attempt to protrude the mutilated support of the lophophores. Its body was so much contracted that the segments were not above one-third their usual size.

At the end of five hours the worm was apparently dead, numbers of infusoria had collected to prey upon it, and the surface of the body presented a roughened appearance as though covered with tubercles. The lophophores were still crawling and swimming about.

At the end of the eighth hour the lophophores had ceased to crawl, but the ciliary action, though feeble and uncertain, still continued. The body of the worm was then covered with a thick fungoid growth, consisting of transparent rod-like filaments three-sixteenths of an inch in length; some of the filaments presented a beaded appearance. All motion of the cilia upon the tentacles had ceased, and these also were being devoured by infusoria.

The above experiment shows that the motion of the cilia continued about twice as long as the mutilated worm gave evidence of life.

Several individuals of *Manayunkia* were observed to be preyed upon, while still living, by large monads, embedded in one or more of the segments, which were sometimes excavated to a considerable degree.

MARCH 4.

The President, Dr. LEIDY, in the chair.

Thirty-seven persons present.

A paper entitled "The Rufous or Thatching Ant of Dakota and Colorado," by Henry C. McCook, D. D., was presented for publication.

Dictyophora as Apsilus vorax.—Prof. LEIDY stated that Mr. Uselma C. Smith, last week, had afforded him the opportunity of examining a wheelless rotifer, attributed to *Apsilus*, which he had found abundantly, last autumn, in a pond at Fairmount Park, attached to *Anacharis*, and likewise in the Schuylkill River, near by, on *Potamogeton.* A number of specimens were observed attached to the sides of the jar, as well as to both the plants contained therein. The specimens being more readily detached from the latter than from the glass vessel, they were seen under more favorable circumstances than previously. They were recognized as *Dictyophora*, first described in 1857; and as a result of the last examinations, Prof. Leidy was led to the opinion that this, the *Apsilus lentiformis* Meczinchow, the *Cupelopagus bucinedax* Forbes, and the *Apsilus bipera*, recently communicated to the Academy by Miss Foulke, all pertain to the same species. In the recent specimens he had recognized the lateral antennæ ending in exceedingly delicate and motionless cils, as indicated by Meczinchow, and which previously, from the wrinkled condition of the specimens detached from hard objects, had escaped his attention. The structure described by Meczinchow as a ganglion, he could not satisfactorily distinguish as such; nor had he been able to detect the arrangement of the excretory canals, as represented by the same author. The lateral view of the animal accords with the figure of *Cupelopagus* as given by Forbes; the body being ovoid, with the mouth of the prehensile cup oblique, and appearing more or less unequally two-lipped. In this view the antennæ are undistinguishable. In all the forms described, the prehensile cup, in the same manner, is projected from and withdrawn within the mouth of a compressed oval or nearly spherical carapace, dotted with minute tubercles. The prehensile cup, substituting the usual rotary organs of rotifers, communicates with a capacious, variably sacculated and dilatable stomach, followed by the ordinary gizzard with its mastax, and then a second sacculated stomach. The ovoidal cloacal pouch opens by an aperture, with radiated folds, externally, some distance in advance of the fundus of the carapace.

The size of the different specimens described varies greatly,

but nevertheless appears to gradate between the extremes. The specimens recently examined were the smallest observed; and in the closed condition measured 0·32 to 0·35 mm. long by 0·3 to 0·32 mm. broad. Former ones described were from 0·35 to 0·6 mm. long by 0·28 to 0·5 mm. broad. For *Cupelopagus*, Forbes gives 0·64 mm. long by 0·56 broad; and for *Apsilus lentiformis*, Meczinchow gives 0·8 mm. long by 0·7 mm. broad.

Miss Foulke enquired whether Dr. Leidy had noticed the secondary sacculated stomach.

The President answered in the affirmative, and stated that the secondary stomach was present in all the forms.

Miss Foulke replied that none of the forms previously discovered had been either figured or described as possessing this organ; that Dr. Leidy's description coincided exactly with that of *Apsilus bipera*, as given by the speaker; and that, in any case, should this form, though differing in every particular save the structure of the mastax, prove to be identical with the *Dictyophora vorax* of 1857, still the differences between *Apsilus bipera*, the *Apsilus lentiformis* of Meczinchow and the *Cupelopagus* of Forbes—viz.: the difference in shape, the presence or absence of antennæ, of the secondary stomach, and of the ciliation of the cup—remain the same, and must separate the forms until proof of their identity can be given.

A New Species of Trachelius.—Prof. H. Carvill Lewis, on behalf of Miss S. G. Foulke, made the following communication:

Having poured some Schuylkill water, freshly drawn from the spigot, into a tube, a white speck was noticed swimming freely about. On being placed in a live-box, and examined with a power of thirty-eight diameters, this speck proved to be a member of the family Trachelidæ, of Ehrenberg.

The family Trachelidæ includes three genera:—*Trachelius*, *Amphileptus*, and *Loxophyllum.*

The genus *Trachelius* consists of but one species, *Trachelius ovum* (Ehr.), from which the form found in the Schuylkill water differs considerably in shape.

Trachelius ovum was described by Ehrenberg as possessing a complex and profusely ramified œsophagus canal, and this opinion was endorsed by Lieberkuhn, also by Claparéde and Lachmann; but W. Saville Kent disputed the point, and believes the appearance of the above structure to be given by the extreme vacuolation of the protoplasm, which would lend a branched intestine-like appearance to the intervening granular sarcode. The observations of the writer, in this respect, entirely coincide with those of Mr. Kent.

Ehrenberg also placed in the genus *Trachelius* two other species, viz., *T. tricophora* and *T. dendropholus*, but these forms, being true flagellates, have been relegated to the genus *Astasia.*

In appearance, the form now to be described is markedly convex on the dorsal side, but is deeply indented longitudinally on the ventral side. The sarcode is highly vacuolate, the vacuoles narrowing towards the centre of the body. The fluid sarcode is granular, and the surface of the body is covered with a network of circles of various sizes, which, when enlarged three hundred and fifty diameters, are seen to be minute globular vacuoles. The snout-like prolongation, at the base of which is situated the oral aperture, is shorter than is usually represented in *Trachelius ovum*.

The principal difference has regard to shape, *Trachelius ovum* being egg-shaped, as indicated by the name, while the form just described is globosely convex dorsally, but flattened with a deep indentation ventrally.

It is a curious fact, and one whose import is not very complimentary to our water-supply, that the habitat of *Trachelius* is universally given as *bog-water*.

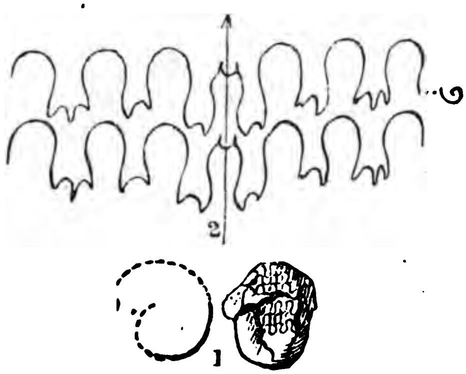
It is proposed to name this new species *Trachelius Leidyi*.

The following was ordered to be printed :—

ON A CARBONIFEROUS AMMONITE FROM TEXAS.

BY PROFESSOR ANGELO HEILPRIN.

Among a limited number of carboniferous fossils obtained from the border of Wise County, Texas, and submitted to me for examination by my friend, Mr. G. Howard Parker, a form occurs which can unhesitatingly be referred to the family *Ammonitidæ*, and to the old genus *Ammonites*. Only a fragment of a single individual of the form in question is to be found, and this, unfortunately, has lost the shell, so that no external ornamentation, if any such existed, can now be detected. What there is of the specimen, however, sufficiently indicates that it was smooth, or destitute of ribs, and that the decidedly globose form was marked by a strong involution of the whorls, which appear almost completely embracing. The umbilical region cannot be clearly made out. The sutural lines of the septa are very clearly defined, and exhibit the ammonitic foliations in very nearly their simplest expression. The lobes and saddles are numerous and closely packed, the general appearance presented by them to the unassisted eye being that of tessellation.



1. Fragments, natural size. 2. Septal sutures, magnified.

The siphonal lobe is considerably the largest, and is split into two prominent tongues by the extension inwards of a deep sinus having approximately the same width as the lateral prongs; the lateral prongs terminate each in two teeth, the inner one of which, counting from the siphonal line, is somewhat longer than the external; the base of the lobal sinus produced anteriorly into two acute sulci. The first lateral lobe terminates in two teeth, the inner or siphonal one the shorter, truncated at the extremity, and sometimes exhibiting indications of apical division;

the second lateral lobes with three teeth, the median one of which is the longest. The saddles are simply rounded, and exhibit, as far as can be seen in the specimen, no traces of crenulation or denticulation along the anterior margin.

This is the first Ammonite, as far as I am aware, that has been detected in any American formation below the mesozoic series. The association with it of characteristic palæozoic forms of life, such as *Zaphrentis*, *Phillipsia*, *Bellerophon*, *Conularia*, *Chonetes*, and *Productus*, leaves no doubt as to its position, and hence we must conclude that here, as well as in India, where Waagen first announced the occurrence of true carboniferous ammonitic forms, the distribution of this highly characteristic group of organisms was not so rigidly defined by the mesozoic line as geologists had been led to conclude. That pre-mesozoic Ammonites will be discovered elsewhere besides in India and Texas there is no reason to doubt; indeed, no assumption could be more illogical than the contrary—and, therefore, the present discovery is in no way specially surprising, and only rather interesting than important. Special interest, however, attaches to this form, as through it and the individuals or fragments of individuals that have been found in the Tejon (Tertiary) rocks of California,[1] we have established in this country the extreme range of the group which it represents.

As to the relationship of the species which I propose to designate *Ammonites Parkeri*, it may be stated that, judged by such characters as the fragment presents, a position must be assigned to it near to *A. antiquus*, Waag., from the Productus-limestone (Salt-Range), of Kufri, India, described and figured in the *Palæontologia Indica* (ser. xiii, pp. 28–9, 1879), of the Geological Survey, and which Waagen refers to the genus *Arcestes* of Suess. A comparison between the septal sutures of our specimen and the Indian one shows a remarkable similarity, indeed, one might almost say identity, existing between the two, the type of structure being practically the same. The principal difference seems to be some very slight and unimportant modification in the lobal denticulations, and the emargination or depression which exists in the saddle, or rather in some of the saddles of the Indian

[1] Heilprin, "On the Age of the Tejon Rocks of California, and the Occurrence of Ammonitic Remains in Tertiary Deposits." Proc. Acad. Nat. Sciences of Philadelphia, July, 1882.

species. The acicular sulci which terminate the sinus in the siphonal or median lobe do not appear in Waagen's drawing, but as this is done on a small scale, the feature in question may have been overlooked. In either case the septal plication is about equally simple or primitive, and indicates a passage by which a transition is effected from the more complicated forms to the still simpler Goniatite. The discussion of the relationship existing between the *A. antiquus* and certain Goniatitic forms described by De Verneuil and Karpinsky from the sandstone of Artinsk, equally applicable in its reference to the American species, is fully set forth by Waagen (*loc. cit.*).

MARCH 11.

The President, Dr. LEIDY, in the chair.

Thirty-nine persons present.

The following papers were presented for publication:—

"A Review of the American Species of the Genus Sphyræna," by Seth E. Meek and Robert Newland.

"Catalogue of Plants collected in July, 1883, during an Excursion along the Pacific Coast in Southeastern Alaska," by Thomas Meehan.

The following was ordered to be printed:—

THE RUFOUS OR THATCHING ANT OF DAKOTA AND COLORADO.

By Henry C. McCook, D. D.

During the autumn of 1883, I had a series of conversations with Mr. B. S. Russell, an intelligent business man, resident at Jamestown, Dakota, concerning a species of ant which inhabits that Territory. At first I was inclined to think that the insect which Mr. Russell described was the Occident ant, especially as the popular name which it bears among the pioneers is the "stinging ant," but further details caused me to suspect that the habits described must be t ose of *Formica rufa*, whose nests I had observed in various parts of Colorado. I accordingly entered into correspondence with Dr. R. G. De Puy, of Jamestown, who forwarded me specimens which proved to be *Formica rufa*. I also gave him a number of points to be noted, and directions as to how to proceed in studying these points; all of which were followed up with accuracy and intelligence, that covered all my inquiries. The notes which follow I have written out from the observations of the two gentlemen above named, and those made by myself in Colorado.

Locality and Site.—The entire rolling prairie country lying between the Cheyenne and James Rivers (Dakota), is dotted with a vast number of ant-hills, which extend westwardly as far as the Missouri River. Mr. Russell could not say whether they are to be seen in the Red River Valley, which, however, is frequently overflowed. I first met the hills of Rufa on the "Divide," northeastwardly from Colorado Springs. Subsequently I saw them in South Park, and afterward in the vicinity of Leadville. They were scattered here and there throughout the woods and clearings, along the trails and near the diggings, within the limits and suburbs of the "Camp," as the place was then (1879) called, and were struggling with the miners, with varying success, to maintain their little "claims." I was struck by the fact that these persistent creatures had been able to push up their domiciles to such high sites, and to hold them against the rigors of the winter frosts.

Specimens sent me from Iowa Gulch, near Leadville, by Mr. C. O. Shields, were taken from an elevation of 11,300 feet above the level of the sea.

This characteristic the American Rufas have in common with their European congeners; the *F. rufa* of Switzerland, for example, is found as far up the Alps as the line of vegetation, further progress being apparently limited by the lack of vegetable growth rather than by the temperature.[1] They may, therefore, be reckoned, both on this continent and Europe, as among the most hardy of the ant fauna, best adapted to contend with severities of cold.

Exterior Architecture of Mounds.—The ant-hills in Dakota are for the most part conical elevations, somewhat flattened at the top (fig. 1). Some present the peculiarity of a square base, giving the hill the shape of a pyramid, whose apex is rounded (fig. 2). Dr. De Puy's measurements show heights varying from one foot and a half, to eight inches. The slopes of the sides in two cases are twenty-one and twenty-three inches respectively; two diameters measured are two feet, and one foot six inches, respectively; and one mound gave a measurement of ten feet around the base. The mounds, according to Mr. Russell, average from twelve to fifteen inches in height, and about eighteen inches in base diameter. They are separated from each other by interspaces of from twenty to sixty feet, and are scattered over the prairie in groups or "villages." Dr. De Puy says that one may travel miles without seeing ant-hills, and then come upon clusters of them.

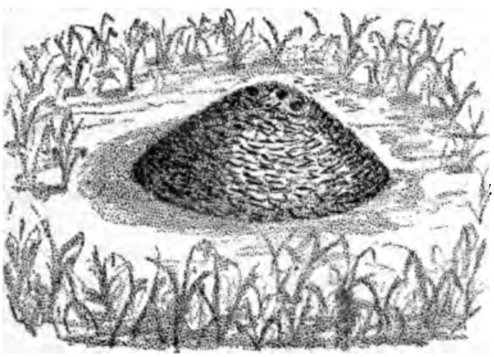


FIG. 1. Conical Mound.—Dakota.

The mounds which I observed in Colorado were chiefly circular elevations of earth, very much flattened at the top (fig. 3). They varied greatly in size, but rarely rose to a greater height than eight inches. One mound observed in South Park and figured, was shaped like a stocking (fig. 4), an odd form certainly, and

[1] *Catalogue des Formicides d'Europe*, by Emory and Forel, p. 450, Mittheilungen der Schweizerischen entomologischen Gesellschaft.

probably caused by the colony pushing up the earth from two independent centres, which in the course of time united. Future labors might possibly correct this, and round the outlines to their normal shape. I saw one formicary in South Park, which was established under a large stone, along the edges of which the gates or openings were placed. Another was seen on the Divide beyond Colorado Springs, domiciled under an old log in a grove. Here several ant-lions (*Myrmeleon*) had established themselves, cannily digging their pits near the very gates of the formicary, quite in the route of the outcoming and ingoing emmets. The largest mound seen by me, and larger than any reported to me, was found near the summit of the Ute Pass. It was a conical heap, four feet long and about one foot high, and looked like a small haycock.

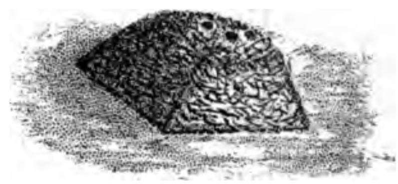


FIG. 2. Mound with Square Base.—Dakota.

Thatching the Roofs.—This Ute Pass ant-hill was thickly covered or thatched with bits of wood, fallen needles and broken sprigs of pine, which had been gathered from the forest debris, lying abundantly in the vicinity. All other mounds in South Park and around Leadville were covered in a like manner, with stalks of grass, twigs, and similar rubbish.

The Dakota ant-hills are thatched in precisely the same way, so that one can easily see the propriety of giving the little artisan the popular title of the Thatching ant. As the colony increases its numbers, and the necessity of internal domestic economy requires enlargement of the nurseries, rooms and galleries, the excavated soil is brought up and naturally is laid upon the thatching. In course of time a new roof of chips and clipped grass is overlaid, and thus in the ordinary growth of a mound there would be an alternation of layers of earth and vegetable substance, the latter falling into decay in due season. This theory of the growth of a hill is confirmed by samples of material taken by Dr. De Puy from the interior of the Dakota mounds, which consists of partly decomposed straw, mixed in smaller proportion with soil. The mound-making ants of the Alleghenies (*Formica exsectoïdes*)

have a similar habit of thatching their hills, but this is not as decidedly developed and characteristic as with the Rufous ant; indeed, so far as my observation extends, it is the exception rather than the rule. The thatching habit is possessed by the European representatives of the species (*F. rufa*), in equal degree with those of our Western plains.

Interior Architecture.—I requested Dr. De Puy to open the hills by sawing down through the middle to the surface of the ground, and shoveling away one of the halves. This exposed a section view of the interior, and presented the remarkable feature shown at fig. 5.[1] The central part of the mound, on or about the level of the surface, was found to be occupied by a ball of twigs (B, fig. 5), about eight inches in diameter; the sticks are longer and thicker than those used upon the roof, some of them being two and a half and three inches long. They were found unmixed with soil or any other substance. Several galleries, about one-fourth of an inch in diameter, led upward from this billet-globe to the surface, having their outlet by circular openings (G) through the thatch. The openings, as seen by Dr. De Puy, were usually near the summit and never more than three in number. In Colorado mounds the openings were spread over the top, and were more numerous. Beneath the faggot-ball a series of galleries, seven in number, extended downward to at least the distance of four and a half feet, the extent of the excavation made by Dr. De Puy. For several inches, immediately below the ball, the galleries were united into a network (n, fig.

FIG. 3. Flat Circular Mound.—Colorado.

[1] I was unfortunately so situated in the South Park and elsewhere in Colorado, in part by the presence of a sick companion, that I could not delay to open the hills there seen, and make a study of the interior. But I have no doubt that they are arranged like those in Dakota. Will not some observer on that field test the matter by opening a few hills?

5) of communicating ways, by galleries running crosswise. Beyond this, they descended separately, having no connection at all, so far as could be observed. At the time that Dr. De Puy opened this nest the ground was already frozen, making the digging quite difficult. No ants were found except a few stragglers who were encamped within the faggot-ball, the mass of the community having evidently taken up their winter-quarters in regions further underground than the point reached, and not improbably below the reach of frost. The purpose of the faggot-ball can now only be conjectured. I can think of nothing quite analogous to it in any formicary known to me; it suggests the globe of curled rootlets and dry grass which I have found within the cavern of that hymenopterous ally of the ant, the humble-bee (*Bombus virginicus*), and perhaps may serve the same purpose, viz.: that of a general nursery and common living-barracks for the family. At least, I have no better conjecture to venture at this time. It is curious to note such resemblances in habit between distantly removed members of an order of insects; but the fact is no more, indeed not so much of a surprise, as to find in the caves of the Texas Cutting ant (*Atta fervens*) a leaf-paper rudely-celled nest, the product of a habit which exists in perfection in those other hymenopterous allies, the paper-making wasps.

Marriage Flight of the Sexes.—Mr. Russell informed me that the ants appear in the spring with the first vegetation, and by the time of hay-harvest, the latter part of July, numerous swarms of "flying ants" are seen. These, of course, are the young males and females who, being matured, abandon or are pushed out of the home-nest for the marriage flight to meet and pair in the air. At this period the swarms are very annoying to the inhabitants. A person driving or riding over the prairie will find himself suddenly in the midst of one of these hosts. The insects settle upon the body, creep into the openings of the clothes, and produce a disagreeable sensation. Such a swarm settled upon the first house which Mr. Russell built, and the carpenters were compelled to abandon it while in the act of shingling the roof. In the hay-field, the harvesters are often obliged to stop to fight off the winged hosts, and those in charge of the hay-wagon to abandon for the time the stack which is being hauled to the barn, on

account of the annoying creatures. The same is true of the grain harvest which comes later, the appearance of the swarms continuing throughout August and into September. The ants, however, do not sting, my informant averred, notwithstanding their popular title of "the stinging ants." The nervous irritation produced by contact with such numbers is the chief annoyance. Some horses show great excitement under the visits of

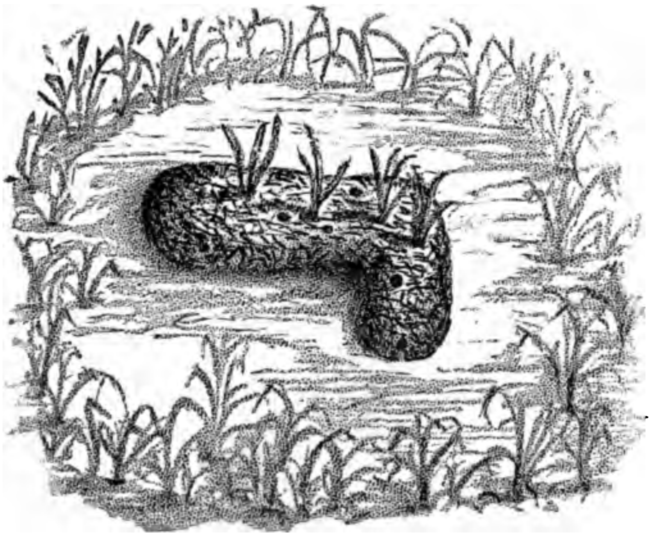


FIG. 4. Stocking-Shaped Mound.—Colorado.

the swarms, to which the more stolid mule is quite indifferent. These flying ants do not get angry when beaten off, and rush at and follow after the parties attacking them as bees do; they whirl round and round in dense masses, alight upon an object within their path, but show no sign of hostility or wish to pursue human or other animals who approach them. The family of ants to which this genus (*Formica*) belongs, has no members possessed of true aculeate organs. The so-called "sting" is really produced by the insect "biting" or abrading the skin with its mandibles, and then ejecting formic acid from its undeveloped stinging organs into the wound. The smart of the acid is quite severe.

A Useful Insectiverous Habit.—Over against this annoyance

Mr. Russell placed an odd advantage, which he had often observed to be of some importance. When a grain-farm is to be opened, and the prairie sod "broken," a large number of men will be employed to manage the plows. These laborers are provided with barracks or a "camp outfit," and by reason both of personal uncleanliness, and the abundance of certain objectionable insects in the prairie grass, soon become infested with parasites. Flannel clothes and blankets are populous by the middle of June. The manner in which the ants are turned in as scavengers may be illustrated by one instance recited.

"One of my camp cooks," said Mr. Russell, "came one day to borrow a horse. 'What for?' I asked. 'I want to go out on the prairie,' was the answer. 'Number Seven (the name of the camp) is in a pretty lively condition; and, to tell the truth, my clothes are full of lice, and I want to go out to the ant-hills and get rid of them.'

"I gave the man the horse; off he drove, stripped piece by piece, and spread his duds and wraps upon the hills. In a few moments they were fairly covered with ants who thoroughly explored and cleaned every fibre, removing both insects and eggs. The cook came back happy and clean. That was a constant custom then (1880), and is continued by the camp people to this day. The 'cleaning up' takes the greater part of a day."

The Dakotans have thus only discovered a formicarian habit which the Indians of the plains, and old pioneers and campers, utilized many years ago.

Enemies and Destructive Agents.—In the "breaking season," many of the ant-hills are torn up by the plows. At such times flocks of blackbirds, both black and yellow-winged species, follow in the furrows, and feed upon the ants. There seems to be no end to the capacity of these birds for this sort of food. The tender larvæ, exposed by the plowshare, are probably also attractive morsels, but Mr. Russell could not say as to that; to him the birds simply seemed to be picking up ants.

In this connection a fact was related which may well excite surprise. The prairie-fires often completely destroy the hills, burn them quite up, and penetrate far enough beneath the surface to leave a hole that would contain a bushel-basket! This statement, made early in the conversation and while I supposed that I was

listening to some observations upon the Occident ant—for Mr. Russell spoke of the insects by their popular name of "stinging ants" — awakened my suspicion. I knew that a mass of gravel-covered dirt, such as the genuine stinging ants—the Occidents—heap up, would not melt away in such wise before a prairie-fire. A few questions satisfied me that I was on the wrong trail, and that no other ant than *Formica rufa* could build a nest liable to such an accident, and that even she could do so I confess I seriously doubted.

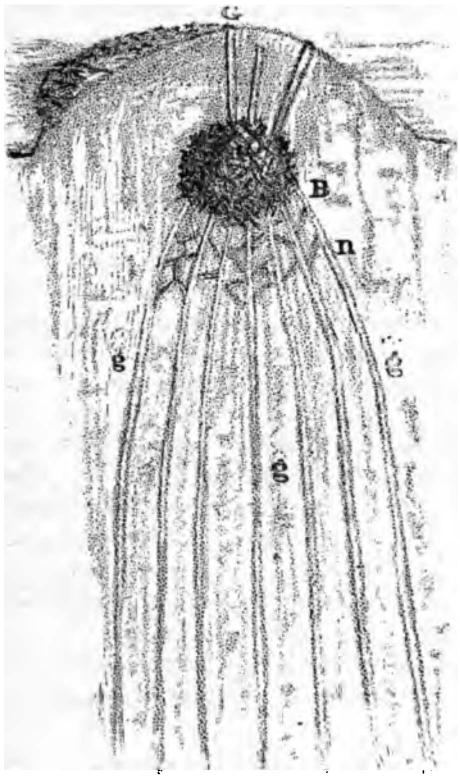


FIG. 5. Half section of mound of *F. rufa*, 4 ft. [illegible] in. below surface. B, central ball of sticks and straws; g, g, g, galleries; n, network of crossing galleries just below the ball; G, gates.

I had no reason to dispute the veracity of my informant, but I thought it quite as well to test his statements. Accordingly I had Dr. De Puy send me samples of the material of the mounds at points below the surface. The results I have already mentioned, and they show that Mr. Russell's statement is entirely credible. The heavy thatch of dried grass upon the roof, the mixture of soil and decayed straw which composes the cone, the faggot-ball at the heart of the hill, together make up a highly inflammable mass. This freely feeds the flames that eat into the subsoil of the prairie, which is decomposed clay and lime. Thus the story of a casual lay observer, which might have been rejected with apparent reason, was confirmed by careful examination.

The mounds exposed to these prairie-fires are frequently preserved from destruction in a rather remarkable way. A narrow

belt of smooth soil generally surrounds the base of a hill (see figures above), on the outer margin of which (in old formicaries especially) springs up a circle of a tall, stiff, thick-stalked grass, such as always grows upon the heaps which the badger throws up when burrowing after gophers. This grass remains green until late in the fall, and when the dry prairie is swept by the flames, it stands as a breastwork around about the mounds, often deflecting the fire or greatly modifying its destructive effects. In this way the formicaries are kept safe within the girdling ranks of the friendly plant.

Concerning the effects upon the ants of the severe winters of Dakota, I could get no information; but as the frost is said to penetrate to the distance of seven feet, I conjecture that the insects must carry their galleries below that depth, though they are doubtless capable of enduring a very low temperature. The surface is thickly covered with snow during winter months, and it is probable that the ants then are in a semi-torpid state. They reappear in the spring with vegetation. It is a difficult matter to exterminate a colony by artificial means.

The saying is current among the people of this section, reported both by Dr. De Puy and Mr. Russell, that if one wants to dig a well he will find water by going down through an ant-hill. I heard the same proverb in Texas applied to the Agricultural and especially to the Cutting ants. My experience is that these popular traditions often have some basis of truth, but in this case I give little credit to the notion. As these Dakota ant-hills are scattered over the whole rolling prairie country at not very great intervals, there certainly can be no likelihood that the people will ever lack water, as a well might be successfully sunk anywhere, according to emmet indications. A rule of this sort could not be worth much in such a country. In Texas the notion is based upon a supposed necessity for the ants to have access to underground sources of water.

March 18.

The Rev. Dr. McCook, Vice-President, in the chair.

Fifty-three persons present.

The following papers were presented for publication:—

"Notes on Species of Fishes improperly ascribed to the Fauna of North America." By David S. Jordan.

"Notes on Tertiary Shells." By Otto Meyer.

The deaths of Dr. A. L. Elwyn, a member, and of Dr. S. B. Buckley, a correspondent, were announced.

Dr. Benjamin Sharp delivered a lecture on the study of biology in Germany introductory to his spring course of lectures on Invertebrate Zoology.

March 25.

The President, Dr. Leidy, in the chair.

Thirty-nine persons present.

The death of J. T. Audenried, a member, was announced.

On Eumeces chalcides.—Prof. Leidy remarked that the little lizard presented this evening had been sent to him by a former pupil, Dr. E. A. Sturge, of Petchaburi, Siam. It appears to be a young individual of *Eumeces chalcides* Gunther, the *Lacerta chalcides* of Lin., and *Lygosoma brachypoda* of Dum. et Bib. It is remarkable for its diminutive limbs, provided with five minute toes. Dr. Sturge says the natives regard it as a snake; and, as is common in such cases, consider it to be venomous.

The following were elected members: Albert S. Bolles, Ph. D., R. W. Fitzell, and Jos. W. Griscom.

The following were elected correspondents: Ludwig von Graff, of Aschaffenberg; G. Dewalque, of Liege; Hans Bruno Geinitz, of Dresden; E. Renevier, of Geneva; Henry N. Moseley, of Oxford; and J. T. Burdon Sanderson, of London.

The following were ordered to be printed:—

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS SPHYRÆNA.

BY SETH E. MEEK AND ROBERT G. NEWLAND.

The object of this paper is to give a review of the American species of *Sphyræna*, with detailed descriptions of the four species found on the Atlantic Coasts of America. The specimens examined by us belong, in part, to the Museum of Indiana University; the rest to the U. S. National Museum. All were collected by Professor Jordan at Havana, Cuba; Key West, Fla., and Wood's Holl, Mass.

The two Pacific species have been fully described by Dr. Steindachner (Ichthyol. Beiträge, vii, 1878, 1–4). The remaining species here mentioned, *Sphyræna sphyræna*, we have not seen.

We are under obligations to Professor Jordan, for use of his library and for valuable suggestions.

Analysis of American species of Sphyræna.

a. Scales large, 75 to 85 in lat. line; origin of first dorsal behind root of ventrals, over last third or fourth of pectorals; body compressed; lower jaw with fleshy tip; maxillary reaching past front of orbit; teeth large. *picuda.* 1.

aa. Scales moderate, 110 to 130 in lat. line; body subterete.

b. Pectorals reaching the front of spinous dorsal; maxillary reaching front of orbit; origin of spinous dorsal behind root of ventrals.

c. Lower jaw with fleshy tip; teeth very strong; scales in lat. line 110. *ensis.* 2.

cc. Lower jaw without fleshy tip; teeth strong; lat. line 130. *guaguanche.* 3.

bb. Pectorals not reaching front of first dorsal; maxillary not reaching front of orbit.

d. Eye large; teeth small; interorbital area convex; median ridge of frontal grove not well developed. *picudilla.* 4.

dd. Eye small; teeth larger; interorbital space flattish; median ridge of frontal grove prominent. *borealis.* 5.

aaa. Scales very small, 150 to 170 in lat. line; origin of spinous dorsal well behind tip of pectorals, before the vertical from root of ventrals; lower jaw with fleshy tip.

e. Body very slender, depth 9 or 10 in length; scales in lat. line 150. *sphyræna.* 6.

ee. Body less slender; depth $7\frac{1}{2}$ in length; scales in lat. line 160 to 170. *argentea.* 7.

1. **Sphyræna picuda** (Bloch and Schneider) Poey. *Great Barracuda; Picuda.*

Umbla minor marina (the Barracuda) Catesby, Fishes Carolina, etc., 1731, tab. i.

Picuda Parra, Peces y Crustaceos de Cuba, 1787, 90, tab. 35, f. 2.

Sphyræna sphyræna, var. *picuda*, Bloch and Schneider, Systema Ichth., 1801, 110 (after Parra).

Sphyræna picuda Poey, Memorias Cuba, ii, 1860, 164 (Havana); Gunther, Cat. Fish. Brit. Mus., ii, 1860, 336 (San Domingo, Puerto Cabello, Jamaica, West Indies, River Niger); Poey, Proc. Ac. Nat. Sci. Phila., 1863, 179, 187 (identification of Parra's figure); Poey, Syn. Pisc. Cub., 1868, 359 (Havana); Poey, Enum. Pisc. Cub., 1875, 95 (Havana); Goode, Bull. U. S. Nat. Mus., v, 1876, 62 (Bermudas); Goode and Bean, Proc. U. S. Nat. Mus., i, 1878, 381 (name only); Goode, Proc. U. S. Nat. Mus., ii, 1879, 116 (South Florida); Goode and Bean, Proc. U. S. Nat. Mus., ii, 1879, 342 (West Florida, no description); Goode and Bean, Proc. U. S. Nat. Mus., ii, 1879, 146 (Cuba, Bermudas, W. Fla. and S. Fla.); Poey, Anal. Soc. Hist. Nat. Esp., 1881, 210 (Puerto Rico); Goode and Bean, Proc. U. S. Nat. Mus., v, 1882, 239 (Gulf of Mexico, no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., v, 1882, 589 (Charleston, S. C.); Swain, Proc. Ac. Nat. Sci. Phila., 1882, 307 (identification of *Esox barracuda*, Shaw); Jordan and Gilbert, Bull. U. S. Nat. Mus., 16, 1882, 412 (West Indies).

? *Sphyræna becuna* Lacépède, Hist. Nat. Poiss., v, Pl. 9, f. 3, 1803, from a drawing by Plumier made at Martinique); ? Cuv. and Val., Hist. Nat. Poiss., iii, 1829, 340 (after Lacépède); Guichenot, Ramon de la Sagra, Hist. Cuba (Havana); Poey, Memorias Cuba, ii, 1860, 164 (Havana); Poey, op. cit., ii, 1860, 398 (identification with *S. picuda;* species repudianda).

Esox barracuda Shaw, Gen. Zool., v, 1804, 105 (based on Catesby).

Sphyræna barracuda Cuv. and Val., op. cit., iii, 1829, 343 (Brazil); Poey, Memorias Cuba, ii, 1860, 398 (species repudianda); Cope, Trans. Am. Phil. Soc. Phila., 1871, 472 (St. Martins).

Habitat.—West Indies and Brazil; north to Pensacola, Charleston and the Bermudas.

Head 3 in length; depth 2 in head. D. V–1, 9; A. I–9.

Scales 10–75 to 85–10 (the cross series counted from lateral line to front of dorsal and anal fins respectively).

Body oblong, slightly compressed, covered with large scales. Head large, maxillary large, nearly $\frac{1}{2}$ length of head, its posterior margin reaching past front of orbit. Lower jaw, with fleshy tip, bluntly conical. Eye rather small, about 6 in head, equals width of interorbital area. Interorbital area concave, with a shallow median groove (as wide a pupil, at posterior edge of orbit), divided by a ridge in front and behind. Supraocular ridge bony and striate. Preocular ridge present.

Teeth large; premaxillary teeth small, little compressed, irregularly set, nearly uniform in size, somewhat thicker and shorter posteriorly; premaxillary with two pairs of very large compressed teeth, their length more than half width of pupil; anterior ones directed downwards, posterior ones downwards and backwards; teeth in lateral series of lower jaw small anteriorly, increasing gradually backwards, when they nearly equal those on palatines; palatine teeth similar to those on lower jaw, arranged in reversed order.

Distance from tip of snout to front of first dorsal $2\frac{2}{7}$ in body; second dorsal spine longest, $1\frac{1}{3}$ in snout; second dorsal and anal equal; anal inserted under first third of soft dorsal; caudal forked, upper lobe the longest; pectorals reaching beyond front of dorsal, $2\frac{1}{2}$ in head; origin of first dorsal slightly behind the ventrals; cheeks and opercles scaly, about twelve rows of scales on cheeks; upper part of head with small imbedded scales.

Color silvery, darker above; sides in young with about ten dark blotches, which break up and disappear with age. Some inky spots, usually on posterior part of body, are very conspicuous in both old and young specimens. Soft dorsal, anal and ventral fins black, except on margins. Pectorals plain, except upper part of its margin, which is black. Fins of very young specimens nearly plain.

This description is made from an examination of some forty specimens, varying in length from two and three-fourths inches to twenty-eight inches. Nearly all were collected by Professor Jordan, at Key West, Florida; a few at Havana, Cuba.

This appears to be the largest of the Barracudas, reaching a length of at least five or six feet. Its mouth is larger and armed with larger teeth than in any other of our species.

Below is given a table of measurements of six specimens from Key West. The proportions are given in hundredths of the length from tip of snout to end of last vertebra.

Extreme length of fish, in inches,	14.75	10.5	7.5	4.125	4.1	2.6
Length of fish from end of snout to last caudal vertebra, in inches,	12.5	8.5	6.2	3.5	3.5	2.3
Greatest depth of body (hundredths of above),	16.	16.	16.	16.	14.	10.
Length of head,	30.5	33.5	34.	37.	36.	36.
Diameter of eye,	5.	6.	6.5	7.	6.5	7.
Length of maxillary,	14.5	16.	15.	15.5	15.	14.5
Width of interorbital area,	5.5	5.	4.5	4.75	5.	5.
With of base of pectorals,	3.5	3.25	3.	3.	2.25	3.
Length of pectorals,	11.5	11.5	11.	11.	11.	10.25
Distance from end of snout, to origin of spinous dorsal,	42.5	44.	45.	49.	49.	53.
Distance from end of snout to root of ventrals,	38.	41.5	42.	44.	48.	53.
Distance between dorsal fins,	20.	19.	18.	16.	18.	23.

2. **Sphyræna ensis** Jordan and Gilbert.

Sphyræna forsteri Steindachner, Ichth. Beiträge vii, 1878, 4 [Cape San Lucas to Monterey (not of Cuv. and Val., an East Indian species, as yet not certainly recognized)].

Sphyræna ensis Jordan and Gilbert, Bull. U. S. Fish Comm., 1882, 106 (Mazatlan); Jordan and Gilbert, op. cit., ii, 1882, 109 (Panama. no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., v, 1882, 624 (Panama; no description).

Habitat.—Pacific Coast of America from Cape San Lucas to Panama (East Indies?).

3. **Sphyræna guaguanche** Cuv. and Val. *Guaguanche: Guaguanche Pelon.*

Sphyræna guachancho Cuv. and Val., Hist. Nat. Poiss., iii, 1829, 342 (Havana; on a drawing by Poey; lapsus for *guaguanche*); Guichenot, Ramon de la Sagra, Hist. Cuba, 165 (Havana).

Sphyræna guaguanche Poey, Memorias Cuba, ii, 1860, 166 (Havana); Poey, Enum. Pisc. Cub., 1875, 96 (Havana).

Sphyræna guagüancho Goode and Bean, Proc. U. S. Nat. Mus., ii, 1879, 146 (Wood's Holl, Mass.; Pensacola, Fla.; Cuba); Goode and Bean, Proc. U. S. Nat. Mus., v, 1882, 239 (Gulf of Mexico; no description); Jordan and Gilbert, Synopsis Fish. N. A., 1883, 411; Jordan, Proc. U. S. Nat. Mus., 1884 (Pensacola, Fla.).

? *Sphyræna güntheri* Haly, Ann. Mag. Nat. Hist., ser. iv, vol. xv, p. 270 (Colon; fide Steind.); Steindachner, Ichthyol. Beiträge, vii, 1878, 6 (after Haly).

Habitat.—West Indies, north to Wood's Holl, Mass., and Pensacola, Florida.

Head $3\frac{1}{4}$ in length; depth 2 in head, D. V–1, 9; A. I–8; scales in lateral line 120 to 130.

Body rather slender, subterete, covered with moderate-sized scales; head large; maxillary small, less than $\frac{1}{2}$ head, scarcely reaching orbit; lower jaw bluntly conical, without fleshy tip; Eye rather large, $5\frac{1}{2}$ in head, a little exceeding interorbital area; interorbital area flat; median groove very shallow, the median longitudinal ridge very small, anterior; supraocular ridge bony, striate; preocular ridge large.

Premaxillary teeth small, 35–40 in number; premaxillary teeth present; anterior palatine teeth larger and more compressed than those on premaxillary, widely set, decreasing in length gradually; teeth in lateral series of lower jaw small and closely-set anteriorly, larger and wide-set posteriorly, about 10 in number; a large compressed tooth at symphysis.

Origin of first dorsal over above tip of pectoral, slightly behind the ventrals; distance between dorsals $5\frac{1}{2}$ in body; distance from tip of snout to spinous dorsal $2\frac{1}{3}$ in body; scales moderate, almost uniform in size; cheeks and opercles scaly; upper part of head with small imbedded scales.

Color light olive, yellowish on soft dorsal; anal and ventral tips of caudal rays black; top of head dark; dark punctulations on upper part of body; spinous dorsal with some dark punctulations.

The description of this species is taken from three specimens from Havana, Cuba, varying in length from six and one-half to eight inches, and from one specimen collected by Mr. Stearns, from Pensacola, Fla., nineteen inches in length.

Below is given a table of measurements of specimens we have examined. The proportions are given in hundredths of length from tip of snout to the end of last vertebra.

	Pensacola, Fla.	Havana, Cuba.		
Extreme length in inches,	19.	7.5	6.75	6.5
Length of fish from end of snout to last caudal vertebra in inches,	15.75	6.12	5.5	4.9
Greatest depth of body (hundredths of length),	16.5	17.	14.75	14.
Length of head,	30.	35.	32.	33.
Diameter of eye,	5.	6.	6.	6.
Length of maxillary,	15.5	15.	14.5	15.
Width of interorbital area,	4.5	5.	5.	5.
Width of base of pectorals,	2.5	3.	3.	3.
Length of pectorals,	....	13.	13.	12.
Distance from origin of spinous dorsal to end of snout,	42.5	46.	44.5	47.
Distance from end of snout to root of ventrals,	38.5	43.	40.5	42.
Distance between dorsal fins,	20.	19.	17.	18.5

We have not seen the original description of *Sphyræna güntheri* Haly, from Colon (Aspinwall). The abridged description given by Steindachner agrees fully with *S. guaguanche*. We follow Poey in restoring the correct orthography of the name, *Guaguanche*.

4. **Sphyræna picudilla** Poey. *Picudilla*.

Sphyræna barracuda Guichenot, Ramon de la Sagra, Hist. Cuba, 165 (Cuba ; fide Poey).

Sphyræna picudilla Poey, Memorias Cuba, ii, 1860, 162, 163, 398 (Havana); Poey, Syn. Pisc. Cuba, 1868, 359 (Havana); Poey, Enum. Pisc. Cub., 1875, 96 (Havana).

Habitat.—Coasts of Cuba.

Head $3\frac{1}{6}$ in body; depth $2\frac{1}{4}$ in head, D. V–1, 9; A. I–9; scales in lateral line 110.

Body rather robust, subterete, covered with scales of moderate size; head rather large; maxillary rather small, about $2\frac{3}{5}$ in head, not reaching orbit.

Jaw with fleshy tip, bluntly conical; eye large, about 5 in head, $1\frac{1}{2}$ times interorbital space; interorbital area flattish; median groove shallow, divided by a very indistinct median ridge; supraocular ridge bony, striate; preocular ridge rather prominent.

Premaxillary teeth small, subconical; dentition as in *Sphyræna borealis*, but slightly weaker; position of spinous dorsal, in comparison to ventrals, variable; distance from tip of snout to origin of spinous dorsal about $2\frac{1}{10}$ in body; pectorals not reaching spinous dorsal; space separating dorsals about $5\frac{1}{2}$ in body; second dorsal equal to and somewhat in advance of anal; cheeks and opercles scaly; small imbedded scales on upper part of head; scales on body moderate, uniform in size. Color light olive, darker above; soft dorsal, anal and ventral fins yellowish; spinous dorsal and pectorals darker; upper parts of preopercle and opercle each with a dark spot; top of head and tip of snout blackish.

S. picudilla is very closely allied to *S. borealis*. Its eye is, however, much larger (when specimens similar in size are compared), and the frontal groove is somewhat different.

The description of this species is taken from four specimens collected by Professor Jordan in Havana, Cuba.

Below is given a table of measurements of the specimens we have examined. The proportions are given in hundredths of the length from the tip of snout to end of last vertebra.

	Havana, Cuba.			
Extreme length of fish in inches, ...	11.75	11.5	11.25	9.5
Length of fish from end of snout to last caudal vertebra in inches, ...	9.85	9.66	9.4	7.85
Greatest depth of body (hundredths of length),	14.	14.50	14.25	14.
Length of head, ...	32.5	31.	32.	32.25
Diameter of eye, ...	6.25	6.	6.	6.75
Length of maxillary, ...	12.25	12.	12.	12.
Width of interorbital area, ...	4.5	4.5	4.5	4.5
Width of base of pectorals, ...	3.	3.	3.	3.
Length of pectorals, ...	10.	9.5	9.	9.
Distance from end of snout to origin of spinous dorsal, ...	47.	47.	47.	46.25
Distance from end of snout to root of ventrals,	47.	47.	48.	46.
Distance between dorsal fins, ...	17.25	17.50	17.75	17.25

5. **Sphyræna borealis** De Kay. *Northern Barracuda.*

Sphyræna borealis De Kay, N.Y. Fauna, Fishes, 1842, 37, pl. 60, f. 196 (New York); Storer, Synopsis Fish. N. A., 1846 (48); Baird, Ninth Smithsonian Rept., 1854, 12 (Beasley's Point, N. J.); Gill, Rep. U. S. Fish Com., 1872, 808 (no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., i, 1878, 381 (Beaufort, N. C., no description); Goode and Bean, Proc. U. S. Nat. Mus., ii, 1879, 146 (Wood's Holl, Mass.); Bean, Proc. U. S. Nat. Mus., iii, 1880, 102 (Wood's Holl, Mass., no description).

Sphyræna spet Jordan and Gilbert, Proc. U. S. Nat. Mus., i, 1878, 381 (Wood's Holl, Mass.); Jordan and Gilbert, Synopsis Fish. N. A., 1883, 411 (in part; not of Lacépède).

Habitat. — Atlantic Coast of U. S. from Cape Cod to North Carolina.

Head 3 in length; depth $2\frac{3}{8}$; D. V–1, 9; A. I–9; scales in lateral line 115–130.

Body rather slender, subterete, covered with moderate-sized scales; head large, maxillary small, less than $\frac{1}{2}$ head, not reaching front of orbit by $\frac{1}{2}$ diameter of eye; lower jaw with fleshy tip, bluntly conical; eye rather small, about 6 in head, scarcely exceeding width of interorbital area; interorbital area convex; median groove very shallow, divided by a distinct longitudinal ridge, especially well-defined immediately before nostrils; supraocular ridge striate; preocular ridge moderate.

Premaxillary teeth small, about 40 in number; front of premaxillary with two pairs of large teeth (sometimes accom-

panied by smaller ones), canine-like; anterior smallest, directed downwards, posterior ones downwards and backwards; anterior palatines larger than premaxillary teeth, and more compressed and widely-set; posterior ones small and closely-set; order of teeth on lower jaw reversed, but similar to those on the palatines, and smaller, about 10 in series; large tooth near tip of lower jaw present.

Origin of dorsal over or slightly in advance of ventrals, well behind point of pectorals; distance between dorsal fins $5\frac{1}{4}$ in length of body; distance from tip of snout to spinous dorsal $2\frac{1}{10}$ in body; scales moderate, somewhat larger behind soft dorsal and anal; cheeks and opercles scaly; small imbedded scales on upper parts of head.

Color olivaceous, silvery below; young with dusky blotches across the back and along the lateral line.

This description is made from eight specimens collected by Professor Jordan at Wood's Holl, Mass., which vary in length from six and one-fourth to eight and one-half inches. The species does not appear to reach a length of much more than a foot. This species shows several points of similarity to *Sphyræna sphyræna*. It is, however, unlikely that the two are specifically identical.

Below is given a table of four specimens. The proportions are given in hundredths of length from tip of snout to end of last vertebra.

	Wood's Holl.			
Extreme length of fish in inches,	6.5			
Length of fish from end of snout to last caudal vertebra in inches,	5.5	5.5	5.2	5.3
Greatest depth of body (hundredths of length),	13.	12.	13.	12.
Length of head,	34.	33.5	32.	35.
Diameter of eye,	5.	6.	5.5	6.
Length of maxillary,	14.5	13.75	12.5	15.
Width of interorbital area,	4.5	5.	4.	5.
Distance from end of snout to origin of spinous dorsal,	47.5	49.	46.	49.
Distance from end of snout to root of ventrals,	48.	49.	46.	49.

6. **Sphyræna sphyræna** (Linnæus) Bloch. *Spet. Barracuda. Sennet.*

Sphyræna et Sudis auctorum Artedi, Gen. Pisc., 1738, 84 (Coasts of Italy).

Esox dorso dipterygio Linnæus, Mus. Ad. Fried., ii, 1754, 100.

Esox sphyræna Linnæus, Syst. Nat., Ed. 10, i, 1758, 313; Ed. 12, i, 1766, 515 (based on Artedi); Gmelin, Syst. Nat., i, 1788, 1389.

Sphyræna sphyræna Bloch, Ichth., 1797, taf. ccclxxxix; Schneider, Bloch, Syst. Ichth., 1801, 109; Risso, Ichth. Nice, 1810, 332 (Nice).

Esox spet Haüy, Encyclopédie Methodique, iii, Poissons, 1787.

Sphyræna spet Lacépède, Hist. Nat. Poiss., v, 1803, 326–8; Bonaparte, Iconografia della Fauna Italica, iii, Pesci plate with part 152 (Mediterranean); Goode, Bull. U. S. Nat. Mus., v, 1876, 61 (Bermudas).

Sphyræna vulgaris Cuv. and Val., Hist. Nat. Poiss., iii, 1829, 327 (Mediterranean); Günther, Cat. Fishes Brit. Mus., ii, 1861, 334 (Mediterranean and Lanzarote); Günther, Shore Fishes, Challenger, 1880, 3 (St. Jago); no description.

Sphyræna viridensis Cuv. and Val., op. cit., iii, 1829, 339 (St. Jago, Cape Verde Islands).

Habitat.—Coasts of Southern Europe and Northern Africa. Islands of Atlantic (Cape Verde; Madeiras; Bermudas).

7. **Sphyræna argentea** Girard. *California Barracuda.*

Sphyrena argentea Girard, Proc. Ac. Nat. Sci. Phila., vii, 1854, 144 (San Diego); Girard, Pac. R. R. Survey, 1859, 59, pl. xiv, 1 (San Diego); Günther, Cat. Fish. Brit. Mus., 1860, 338 (San Diego); Steindachner, Ichthol. Beiträge, vii, 1 (Cape San Lucas to Monterey); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, iii, 29 (San Diego); Jordan and Gilbert, op. cit., 1880, iii, 456 (San Francisco, Monterey, Santa Barbara, San Pedro and San Diego; no description); Jordan and Jouy, op. cit., iv, 1881, 13 (San Pedro and Santa Barbara); Jordan and Gilbert, op. cit., iv, 1881, 44 (Monterey to Santa Barbara); Jordan and Gilbert, op. cit., v, 1882, 358 (identification of *Sphyræna lucasana* Gill; Cape San Lucas).

Sphyræna lucasana Gill, Proc. Ac. Nat. Sci. Phila., 1863, 86 (Cape San Lucas).

Habitat.—Pacific Coast of America from San Francisco to Cape San Lucas.

This species reaches a length of about three feet. We are not able to positively distinguish this species from the published accounts of *S. sphyræna.* We have, however, no doubt that differences will appear on the actual comparison of specimens.

CATALOGUE OF PLANTS COLLECTED IN JULY, 1883, DURING AN EXCURSION ALONG THE PACIFIC COAST IN SOUTHEASTERN ALASKA.

BY THOMAS MEEHAN.

Few new plants have been discovered along the northern Pacific coast, since its examination by the naturalists who accompanied the navigators and explorers of the earlier part of the century; and the results of their labors, as given in Rothrock's *Flora of Alaska*, the *Geological Survey of Canada*, and other lists, seem scarcely to warrant any addition to the botanical literature of this part of the continent. The local histories of these plants are, however, yet not well known; and it seems to me I may add a little to this knowledge by some account of the collection made during July, 1883, in a short trip on the "Idaho," a mail steamer from Portland to Sitka, and trading at various points along the coast at many Indian-fishing settlements.

My object in the journey was simply to get a glance at this interesting country, and the price demanded by the company for my wife, son, and myself, $375, for first-class accommodations for a month, not seeming unreasonable, we took the journey. The only opportunity for collecting was during the few hours spent in taking out and re-shipping stores at the stopping places; and the fact that in this short time and hurried gathering, I was able to collect 275 species, indicates a greater richness of the flora than I expected before starting on the journey. In a number of places, also, the botanizing had to be done under an umbrella in pouring rain, which wholly forbade entrance into the forests, and led to an examination of the shore-lines alone. Rothrock's list embraces but 590 species, including grasses and carices, which, fearing I should not have time in my rapid journey, I seldom touched. My impression is that when we shall have had better opportunities of examining the interior of the territory, the list of Alaskan plants will be still more largely increased. It is true my list embraces the contiguous territory; but probably all north of the Columbia River—of the Straits of Fuca at least—may be regarded as one geographical area up and down which plants may be expected to travel.

Since the publication of Rothrock's Catalogue, other collectors have added to our knowledge of localities, though their work has

not been published. The Herbarium of the Academy of Natural Sciences of Philadelphia is rich through the labors of Harrington, Kellogg and Davidson, and the author is indebted in a great measure to their specimens for assistance in the identification of his own.

The collection made at Bartlett (sometimes called Hood's) Bay, is probably the first made at that point; and it is the interest attached to this that, chiefly, leads the author to publish the paper.

On our return from Chilcat (written Tchillcat in some charts) down the Lynn Channel, we ran up Icy Straits into Glacier Bay, to the fifth or Muir Great Glacier; and on our return, passed in between the Beardslee Islands to the mainland at a point opposite Cross or Icy Sound in about lat. 58.30, called on our chart Bartlett Bay. This is on a peninsula formed by the junction of Icy Sound with the Lynn Channel, and nothing seems to be known of this immense tract of land, except what can be gathered from the not over-friendly Indians who live along the coast in the fishing season. An Indian trader, Mr. Richard Willoughby, told the author that at a point about twenty-five miles above this he had traveled northwest across the peninsula for some forty miles to Pyramid Harbor, near the mouth of the Chilcat, as he was understood to say wholly on ice. It is quite probable that at about a hundred miles north from Bartlett Bay the country is a vast ice-sheet, and there were circumstances which seemed clearly to show that at no great distance of time in the past the whole of the western portion of this peninsula was covered by ice; while on the eastern shore, on Lynn Channel, the forest trees showed the mixture of trees of various ages common to old forests; the forests of the western slope were all comparatively young, and none were evidently over fifty years of age. The earth to fifty feet or more in depth in many places was composed wholly of glacial drift, and on this were the young forest trees. Some remarks on these features more in detail are given at page 187, 1883, of the *Proceedings of the Academy.* Since they were published, Mr. Dall has kindly informed the author that there is historical evidence to show that this part was covered by ice at about the end of the past century. This being so, it becomes a matter of considerable interest to ascertain how so many plants have maintained an existence here—whether they

have appeared since the recession of the ice, or whether they managed to retain their hold during the whole continuance of the ice-sheet.

At our landing place a small stream entered the ocean, and this stream came through a swampy valley a few hundred feet wide, extending into the land for an unknown distance. The hills of drift were on each side of this valley. All the plants were collected within a quarter of a mile of the mouth of this stream, and there is every reason to believe that a larger number of species might have been collected had there been time or opportunity for more inland research along its line. By the margin of the swamp were rocks from five to ten or twenty feet above its ground level, and not covered by drift; but on the more level rocks often with a few feet of sand, which had evidently blown in during the course of years. Yet with every opportunity to do so had there been time for the work, very few of the plants along the line of the stream had extended to the drift deposits close by. These plants were not brought there by the drift. We may say almost with certainty that they were there during the period when the land was covered by ice. How did they manage to maintain themselves under these circumstances? Were they wholly covered by ice? or were there rifts and clefts in the ice-sheet deep enough to allow plants a summer of recuperation?

I think we need not regard the last consideration as one of necessity. There is reason to believe that under a low temperature plants will retain vital power for an indefinite period. Mr. Douglas, of Waukegan, Illinois, once sent to me young trees of *Catalpa speciosa*, that had been placed in sand in a cool cellar and forgotten a year, and that remained the whole twelve months dormant, and grew the next year when planted out. Dr. Maxwell T. Masters, of London, has called attention to the case of an orchid which, as I remember, remained under ground a whole season without growing, and this has been adduced as a probable explanation of the non-appearance in some seasons of plants which are plentiful in others. If a plant will remain dormant one, two or three years under unfavorable conditions for growth, who shall say how much longer a period they may not live, under conditions favorable to dormancy only? I have a strong suspicion that just at or below the freezing-point roots may live for an unlimited number of years; and that a district might be

covered by an ice-sheet for a quarter of a century or more, and the plants beneath retain full vital powers.

By referring again to my remarks on some geological features of this part of Alaska (page 183, *Proc. Ac.*, as cited), it will be seen by a sunken forest of apparently modern trees there is reason to believe that in comparatively recent times this peninsula was clothed with a rich vegetation—that it was of a sudden partially submerged and perhaps as suddenly elevated again a little—and that all these changes have been the work of but a few hundred years. The plants in question have probably survived through all these changes, though perhaps wholly ice-covered at times, and have not been brought here by modern agencies; and if these suggestions, which are offered only as great probabilities, should get fuller confirmation from any one in the future who may have opportunities of going more fully into an investigation of the spot, it will give additional interest to the study of botany in connection with the great changes which have been going on over the surface of our globe.

From other botanical evidences which southeastern Alaska affords, I am inclined to believe that geological changes in this section have not required the long periods to effect which geologists usually demand. In the vicinity of the Davidson Glacier, a little below Pyramid Harbor, layers of ice may be seen covered by sand and earth, and prevented from rapid thawing—only an occasional spot showing the icy bed beneath—and yet alder and other plants grow within a few hundred yards. On the other hand, near the Muir Glacier, at the point where the river-bed beneath the ice diverges from the glacier's direct course, the only sign of arborescent vegetation is from a few score of willow-bushes, scattered on the mountain-side. Beneath the drift, hundreds of feet below, is a forest buried as it grew. Pines, alders, and similar plants spread so readily in this region, that these bare hill-sides would assuredly be clothed thickly with a forest vegetation, thus replacing the forests which have been swept away, if there had been time enough for the purpose. The immense area and great depth of these treeless drift formations would surely be regarded as requiring perhaps many centuries for deposit, but for the evidence which the botanical observations afford that the whole change must have taken place within very recent times.

In making the catalogue I have followed the example set by Mr. Watson, in the Bibliographical Index; a general view of the relation of the species to each other is furnished by the natural orders in systematic sequence—all the rest is alphabetical. In a systematic work on botany, an alphabetical index appears at the end. A catalogue should be itself an index, as its chief use is for reference and not for systematic study.

RANUNCULACEÆ.

Aconitum napellus Linn. Harrisburg, Alaska.

Actæa spicata, var. **arguta** Watson. Pyramid Harbor, Alaska.

Aquilegia formosa Fisch. Harrisburg, Alaska.

Caltha palustris L. Pyramid Harbor, Harrisburg, Alaska.

Coptis asplenifolia Salisb. Fort Wrangel, Alaska.

Seen also at Sitka and many places through Alaska, but very seldom could I find fruit. The fine specimens from Fort Wrangel were the only good ones found, and I had to look a long time there among the plants before any were seen.

Ranunculus flammula, var. **reptans** Meyer. Departure Bay, B. C., in summer-dried, muddy places.

R. orthorhynchus Hook. Fort Wrangel, Alaska.

Some of the flowers were of a deep orange-brown, but mostly of an ordinary butter-cup yellow. Plant three to four feet high.

R. recurvatus Poir. Fort Wrangel, Alaska.

R. repens L. Harrisburg, Alaska.

CRUCIFERÆ.

Arabis alpina L. Killisnow Island, Alaska.

A. hirsuta Scop. Chilcat Inlet, Harrisburg, Alaska.

A. petræa, var. **ambigua** Regel. Chilcat Inlet, Harrisburg, Killisnow Island.

Common on rocks in Alaska.

Cochlearia Anglica L. Harrisburg, Alaska.

C. officinalis L. Idaho Inlet, a newly explored arm of Cross Sound, by our steamer "Idaho."

A small form growing in mud, covered at high tide. Plants from half inch to one and one-half inches in length, in full flower, but no mature fruit.

Erysimum cheiranthoides L. Killisnow[1] Island, Alaska.

But common through the territory, growing from one foot high to sometimes five feet.

Nasturtium amphibium R. Br. Harrisburg, Alaska.

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[1] Kenasnow on some maps.

VIOLACEÆ.

Viola sarmentosa Dougl. Harrisburg, Alaska. Perfect flowering.

V. sarmentosa. In open gravelly places. Departure Bay, Alaska. Cleistogamous.

Arenaria lateriflora L. Pyramid Harbor, Alaska.

Cerastium alpinum L. Bartlett Bay, Alaska.

Honkenya peploides Ehrb. Killisnow Island, Alaska.

I did not see Indians eating this, but I saw it in their canoes, brought from places where it grew; and often saw pieces lying around where their camp-fires had been. I believe they cook and eat it.

Spergula arvensis L. Harrisburg, Alaska; clefts of rocks by the seaside.

Stellaria borealis Bigel. Harrisburg, Sitka, Alaska.

S. crispa Ch. and Sch. Pyramid Harbor, Harrisburg, Alaska. Common.

S. longifolia Muhl. Harrisburg, Alaska.

Sagina procumbens L. Sitka, Alaska.

PORTULACACEÆ.

Claytonia sarmentosa C. A. Mey. Fort Wrangel, Alaska.

This is evidently the plant intended by Pursh as *C. lanceolata*, but I believe my plant is what is regarded as above. It is common along the coast, and is extremely variable. Eaten by Indians.

Montia fontana L. Sitka, Alaska.

I saw only some half dozen small plants under a cabin set on logs, and suspected it was an introduced plant.

HYPERICACEÆ.

Hypericum Scouleri Hook. Departure Bay, B. C.

MALVACEÆ.

Sidalcea malvæflora Gray. Victoria, B. C.

This appears to me somewhat different from the plant of the more southern portion of the continent; but Mr. Serano Watson decides it to be this species. Two to three feet high.

GERANIACEÆ.

Geranium erianthum D. C. Killisnow Island, Alaska.

G. pusillum Lin. Port Townsend, W. T.; Victoria, B. C.

Impatiens fulva Nutt. Harrisburg, Alaska.

SAPINDACEÆ.

Acer rubrum L. Pyramid Harbor, Alaska.

LEGUMINOSÆ.

Astragalus alpinus L. Pyramid Harbor, Alaska.

A. hypoglottis L. Bartlett Bay, Alaska.

Lathyrus maritimus Bigl. Pyramid Harbor, Alaska.

Lupinus Nootkatensis Don. Bartlett Bay, Alaska.

L. micranthus Doug. Victoria, B. C.

Oxytropis Lamberti Pursh. Pyramid Harbor, Alaska.

Psoralea physodes Dougl. Port Townsend, W. T.

More capitate than I have before seen it.

Trifolium involucratum Willd. Port Townsend, W. T.; Victoria, B. C.

T. microdon Hook. Port Townsend, W. T.: Victoria, B. C.

Vicia gigantea Hook. Sitka: Killisnow Island, and other places in Alaska.

ROSACEÆ.

Amelanchier alnifolia Nutt. Astoria, Or.

A dwarf variety, with large black, and excellent fruit.

Dryas octopetala L. Bartlett Bay, Alaska.

Plants without inflorescence. Glacier Bay, near Muir Glacier, a single large plant with fruit, on a moraine deposit.

Fragaria chilensis Duch. Chilcat Inlet, Alaska, also in Bartlett Bay.

This species interested me by the dark color of the upper surface of the leaves as contrasted with the lower; the deeply incised first (autumn) leaves; the enormous runners, often two feet long before bearing a plant; the very long—often over a foot—and slender common peduncles of the later flowers, and very short, often nearly sessile common peduncles of the earliest flowers; the very large flowers; and pale, scarcely red fruit. The Indian boys and girls go out and collect them, as our boys and girls do. At Killisnow Island, I did not see them growing, but Indian women brought them to our landing, and knew enough of our language to ask "ten cents" for small measures of them.

F. vesca L. Departure Bay, B. C.

I believe I saw it in Alaska, but have no specimen.

Geum macrophyllum Willd. Pyramid Harbor. Common in Alaska.

Neillia opulifolia B. & H. Departure Bay, B. C.

Nuttallia cerasiformis T. & G. Astoria, Or.

Pyrus rivularis Doug. Astoria, Or.; Victoria, B. C.; Sitka, Alaska.

P. sambucifolia Ch. & S. Pyramid Harbor, Alaska.

I saw but one plant, on an Indian trail so steep and slimy, it was impossible to climb. It had no fruit; but on the trail were

several red fruit, evidently of this species, but not one-fourth the ordinary size, about the size of an elderberry. At Sitka I saw the plant with the full-sized fruit, half mature, that we see further south.

Potentilla fragiformis Willd., var. **villosa.** Chilcat Inlet, Sitka, Alaska.

Varying in habit.

Prunus emarginata Walp., var. **mollis.** Astoria, Or.

Rosa gymnocarpa Nutt. Departure Bay, B. C.

In open places a shrub two to three feet, but along the trail through woods not too dense, it would rise six to eight feet high; and the red fruit, one to three on a common peduncle, made a very ornamental shrub.

R. Nutkana Presl. (**R. cinnamomea** Hook). Pyramid Harbor, Alaska; Victoria, and some forms everywhere.

Varies very much in size and form of fruit, sometimes having them as large as Damson plums; seems generally characterized by very large stipules, especially on the upper part of the flowering stem.

Rubus leucodermis Dougl. Departure Bay, B. C.; Astoria, Or.

Leaves commonly pinnate, with five leaflets. Fruit better than the Eastern Black Cap, which it resembles.

R. nutkanus Moçino. Killisnow Island; but very common throughout the coast.

R. spectabilis Pursh. Killisnow Island; but everywhere throughout Alaska.

The fruit is most prevalently of an amber-yellow, but often scarlet or red. The flavor is wholly that of a blackberry, rather than of a raspberry, and they vary very much in size. The Indian women of Sitka have very large ones, which they sell on the road-side. At Killisnow Island I saw two Indian women, whom I encountered in the woods, gathering the soft green tops of the summer shoots in large bunches. They made signs to me that they ate them; I suppose cooked.

R. stellatus Smith. Sitka.

Though the plants seemed abundant, many flowers were abortive, and a large number had but a single red carpel, or two or three only. I had trouble to find a few with perfect berries.

R. ursinus Ch. & S. Departure Bay, B. C.

Spiræa Aruncus L. Harrisburg, Alaska; Departure Bay, B. C.

S. discolor Pursh. Victoria, B. C.; Harrisburg, and common along the Alaskan coast.

I am not able to decide to which of the varieties these northern

forms should be referred, but they strike one differently from the plant I have collected in the Rocky Mountains, *S. dumosa.*

Sanguisorba canadensis C. & S. Bartlett Bay, Alaska.

SAXIFRAGACEÆ.

Heuchera glabra Willd. Harrisburg, Alaska.

H. micrantha Dougl. Harrisburg, Alaska.

Parnassia palustris L. Bartlett Bay, Alaska.

Ribes bracteosum Dougl. Pyramid Harbor, Alaska, and common along the coast.

Very striking by the stems as thick as one's finger, and very stout annual shoots, enormous maple-like leaves, long leaf-stalks, and racemes eight to ten inches long. The berries are called by the Indians ".Shaum," as I understood them. They are gathered and preserved in fat for winter use.

R. divaricatum Dougl. Port Townsend, W. T.

R. lacustre Pois. Port Townsend, W. T.; Harrisburg, Alaska.

R. Hudsonianum Richard. Fort Wrangel, Alaska.

This seems to grow only about stumps or dead logs. I believe the berries are used by Indians, as are those of *R. bracteosum.*

R. sanguineum Pur. Departure Bay, B. C.

R. subvestita Hook.?

Fruit very large—as large as the English gooseberry, which even the foliage somewhat resembles. The berry is covered by viscid hairs, by which even a large berry will adhere to the finger. The color of the fruit is scarlet, but the flavor is insipid. The shrub grows about four to five feet high.

Saxifraga leucanthemifolia Mx. Harrisburg, Alaska.

S. tricuspidata Retz. Chilcat Inlet, Alaska.

Tellima grandiflora R. Br. Harrisburg, Alaska.

Tiarella trifoliata L. Port Townsend, W. T., and northwards.

CRASSULACEÆ.

Sedum spathulæfolium Hook. Victoria, B. C.

S. Rhodiola D. C. Bartlett Bay, Alaska.

DROSERACEÆ.

Drosera rotundifolia L. Fort Wrangel, Alaska.

ONAGRACEÆ.

Circæa alpina L. Harrisburg, Alaska.

Epilobium affine Bong. Fort Wrangel, Sitka, Alaska.

E. alpinum L. Pyramid Harbor, Killisnow Island, Alaska.

E. latifolium L. Pyramid Harbor, Muir Glacier, Alaska.

E. minutum Lindl. Fort Wrangel, Alaska.

E. paniculatum Nutt. Departure Bay, B. C.

E. spicatum, Lam. Port Townsend, W. T.

About eighteen inches or two feet, with narrow leaves ($\frac{1}{4}$ inch), tapering gradually at both ends. Victoria, B. C., two to three feet, leaves broader; Killisnow Island, Alaska, four to five feet high, leaves one to one and one-half inches broad, spike leafy, and inclined to be paniculate.

CUCURBITACEÆ.

Echinocystis lobata T. & G. Columbia River, above Astoria, Or.

UMBELLIFERÆ

Archangelica Gmeleni D. C. Harrisburg, Kaigan, and other places in Alaska.

The few whites we met called it "celery." In many Indian lodges I saw bundles of fresh flower stems, and in some cases Indians peeling or stringing them as we do rhubarb stalks, and eating them raw with apparent relish.

It is interesting to note that Linnæus, in his tour in Lapland, notes that the Laplanders use this plant in the same way.

Crantzia lineata Nutt. Columbia River, above Astoria, Or.

Heracleum lanatum Mx. Harrisburg and many other places in Alaska.

Geological survey of Canada says Indians eat the leaf-stalks; but I saw no evidence of this in Alaska.

Ligusticum scoticum L. Idaho Inlet, Killisnow, Harrisburg, Alaska.

Common along the Alaskan coast.

Œnanthe sarmentosa Presl. Departure Bay, B. C.

Sanicula Menziesii Hook & Arn. Port Townsend, W. T., Victoria, B. C.

Sium cicutæfolium Gmel. Astoria, Or.

ARALIACEÆ.

Fatsia horrida B. & H. Pyramid Harbor, Harrisburg, and other places in Alaska.

Often forming dense underbrush in forests, growing four to eight feet high, and making traveling impossible unless with great labor. An Indian explained to me that it was in common use with them as a medicine.

CORNACEÆ.

Cornus stolonifera Mx. Pyramid Harbor, Alaska.

C. canadensis L. Sitka, Fort Wrangel, Alaska.

CAPRIFOLIACEÆ.

Lonicera hispidula Dougl.

I see no difference between the yellow and red forms, though they strike one as distinct when growing. The red form, Port Townsend, W. T.

L. involucrata Banks. Kaigan, Alaska.

Seemingly different from the Colorado plant, but chiefly in size and habit: The plant has a sarmentose or half-climbing character. It grows up the hemlock trees as they grow; and, when the lower branches of the hemlock die, the stems of the Lonicera remind one of grapevines. But the plant travels along the lower living or dead branches of the hemlock, outwards to the light. Away from trees they are self-supporting, but yet the branches are somewhat pendulous. In such cases eight to ten feet high.

Linnæa borealis Gron. Port Townsend, W. T.

Sambucus racemosa Mx. Fort Wrangel, Alaska.

Familiar as I am with the var. *pubens* of the Allegheny and Rocky Mountains, I could hardly believe the forms deserved to be regarded as identical after seeing the Alaska plants, especially those about Fort Wrangel. The inflorescence was strictly racemose, which the more eastern form is not. Shrubs six to ten feet, and as wide, covered with brilliant scarlet berries, were extremely attractive.

Symphoricarpus racemosus Mx. Victoria, B. C.

Viburnum ellipticum Hook. Pyramid Harbor, Alaska.

RUBIACEÆ.

Galium asprellum Mx. Victoria, B. C.

Slender habit. Harrisburg and Sitka, coarse and straggling.

G. triflorum Mx. Port Townsend, W. T.; Victoria, B. C.; Harrisburg, Sitka, Alaska.

Leaves getting broader from each location northwards.

COMPOSITÆ.

Adenocaulon bicolor Hook. Port Townsend, W. T.

Achillea millefolium L. Port Townsend, W. T.; Victoria, B. C.; Harrisburg, Alaska.

Much more vigorous and hairy than the eastern plant, and generally with deep rosy, occasionally with pinky white, but rarely, if ever, with pure white flowers.

Anaphalis margaritacea Benth. Bartlett Bay, Chilcat Inlet, Alaska.

Antennaria alpina Gaert. Chilcat Inlet, Bartlett Bay, Alaska.

Arnica Chamissonis Less. Bartlett Bay, Alaska.

Aster Douglasii Hook. Columbia River, Astoria, Or.

Bahia lanata Nutt. Port Townsend, W. T.; Victoria, B. C.

Cnicus edulis Gray. Columbia River, above Astoria, Or.; Departure Bay, B. C.

Erigeron acre L. Bartlett Bay, Alaska.

E. alpinum L. Bartlett Bay, Alaska.

E. Philadelphicum. Victoria, B. C.

E. speciosum D. C. Port Townsend, W. T.

Gnaphalium purpureum Lin. Port Townsend, W. T.

Hieracium albiflorum Hook. Port Townsend, W. T.

H. cynoglossoides Amt. Touv. Port Townsend, W. T.

H. Scouleri Hook. Departure Bay, B. C.

Leontodon hirsutum Hook. Port Townsend, W. T.

Densely hairy; Victoria, B. C., slightly hairy and more slender than the Port Townsend plant.

Madia filipes Gray. Port Townsend, W. T.; Victoria, B. C.

M. Nuttalliana Gray. Port Townsend, W. T.; Victoria, B. C.

Micromeris Bigelowii Gray. Victoria, B. C.

Nabalus alatus Hook. Harrisburg, Fort Wrangel, Sitka, Alaska.

Pyrethrum Parthenium L.

A single plant on the Columbia River, four miles above Astoria, most likely introduced, but worth recording as noting the commencement of naturalization.

Senecio pseud-arnica Hook. Killisnow Island, Alaska.

Solidago elongata Nutt. Victoria, B. C.

S. multiradiata Ait. Bartlett Bay, Alaska.

Sonchus oleraceus L. Astoria, Or.; Departure Bay, B. C.

Quite common, but I suppose introduced in some way.

Taraxacum palustre Lin. Departure Bay, B. C.; Port Townsend, W. T.

Campanula rotundifolia L. Chilcat Inlet, Alaska.

In the crevices of rocks; the flowers very large, and the stems very stout. Indian name "narl," and represented as "good for medicine."

C. Scouleri Hook. Departure Bay, B. C.

About four inches high, densely leafy, and leaves narrow in open rocky places; a foot high, slender, leaves broad and scattered in somewhat shady places.

ERICACEÆ.

Arbutus Menziesii Pursh. Departure Bay, B. C.

Bryanthus glanduliferus Gray. Bartlett Bay, Alaska.

Cassiope Mertensiana Don. Bartlett Bay, Alaska.

C. tetragona Don. Bartlett Bay, Alaska.

Gaultheria Shallon Pursh. Port Townsend, W. T.

One to two feet high; Kaigan and other places in Alaska, two to four feet or more, and forming a dense undergrowth rendering the forest almost impassable.

Kalmia glauca L. Fort Wrangel, Alaska.

Ledum palustre L. Fort Wrangel, Sitka, Alaska.

Leaves broader as the plant extends northwards.

Menziesia ferruginia Smith. Fort Wrangel, Sitka, and Pyramid Harbor, Alaska.

Moneses uniflora Gray. Bartlett Bay, Alaska.

Pyrola chlorantha Swartz. Pyramid Harbor, Alaska.

P. rotundifolia Lin. Port Townsend, W. T.

P. secunda Lin. Pyramid Harbor, Alaska.

Vaccinium ovalifolium Sm. Fort Wrangel, Alaska.

V. ovatum Pursh. Columbia River, above Astoria, Or.

V. parvifolium Sm. Columbia River, above Astoria, Or.

V. uliginosum L. Bartlett Bay, Alaska.

V. Vitis-Idæa L. Sitka, Fort Wrangel, Alaska.

PLUMBAGINACEÆ.

Armeria vulgaris Willd. Victoria, B. C.

PRIMULACEÆ.

Dodecatheon Meadia L. Killisnow Island, Alaska.

Var. *macrocarpum* probably. Clefts of rocks along the shore.

Glaux maritima L. Fort Wrangel, Alaska.

Primula borealis Duby. Bartlett Bay, Alaska.

Trientalis Europæa Linn. Sitka, Alaska.

T. Europæa, var. *arctica* Fisch. Harrisburg, Alaska.

OLEACEÆ.

Fraxinus Oregana Nutt. Victoria, B. C.

But perhaps introduced.

GENTIANACEÆ.

Gentiana amarella L., var. acuta Engel. Departure Bay.

POLEMONIACEÆ.

Collomia heterophylla Hook. Columbia River, above Astoria.

There is in the Herbarium of the Academy of Natural Sciences of Philadelphia, a specimen of this, and perhaps from the same locality, simply marked "Gilia, Columbia River." In the same paper is a specimen marked *Navarretia heterophylla* Benth., "from Durand's Herbarium," which is almost smooth, not viscous as this is, and accords with the figure in Hook. Bot. Mag., t. 2895, which this and Nuttall's specimen scarcely do.

BORRAGINACEÆ.

Mertensia maritima Don. Killisnow Island, Alaska.

SCROPHULARIACEÆ.

Boschniakia glabra C. H. Meyer. Pyramid Harbor, Alaska.

Among alders, apparently in the track of a receding glacier. A long woody thread descends from the base of the scaly flower stem, but in the haste of collecting I did not find to what the thread was attached, if it were attached at all. The Indians make no use of the plant, but class it with plants which are "cultash" (no good). Their name for this is "Asquakali."

Castillija hispida Benth. Pyramid Harbor, Alaska.

C. miniata Dougl. Victoria, B. C.

C pallida Kunth. Pyramid Harbor, Alaska.

Common through Alaska, and varying very much, especially in the colors of the bracts and flowers.

Euphrasia officinalis L. Bartlett Bay, Alaska.

Mimulus dentatus Nutt. Astoria, Or.

Though from the numerous variations of *M. luteus* L. this might be regarded as but a variety of that species, it has a very distinct appearance when seen growing. The dark, blue-green, thick leaves are particularly striking. This might be owing to the sub-saline locality—so many maritime plants having foliage of this character; but the normal *M. luteus* may be often seen in similar situations, and without these characters. Dr. Gray, in *Botanical Gazette*, now regards it as a good species.

Mimulus luteus L. Harrisburg, Alaska.

Common along the coast.

Pedicularis palustris, var. *Wlassoviana* Bunge. Bartlett Bay, Alaska.

Scrophularia Californica Cham. Astoria, Or.

Veronica scutellata L. Departure Bay, B. C.

V. alpina L.? Bartlett Bay, Alaska.

LENTIBULARIACEÆ.

Pinguicula vulgaris L. Bartlett Bay, Alaska.

LABIATÆ.

Brunella vulgaris L. Victoria, B. C.

This does not strike me quite like the introduced form of the Eastern States, and is most likely indigenous.

Galeopsis Tetrahit L. Sitka, Alaska.

A patch of a few yards in extent, but seemingly many years established, on the shore, near the old city, was the only locality noted on the journey, and suggests that the plant may have been a Russian introduction.

Mentha canadensis L. Departure Bay, B. C.

Micromeria Douglasii Benth. Port Townsend, W. T.

Stachys ciliata Doug. Victoria, B. C.

Damp, grassy places. A very ornamental plant.

PLANTAGINACEÆ.

Plantago major, var. *Asiatica* D. C. Fort Wrangel, Alaska.

P. major, var. *minima* Dec. Departure Bay, B. C.

Both these forms grow in saline soil, and the location can have no influence on their very distinct appearances.

POLYGONACEÆ.

Polygonum viviparum L. Killisnow Island, Alaska.

Rumex domesticus Hart. Hoona (Bartlett Bay).

Petioles a foot long, and half an inch wide. Leaf-blade about a foot long and nine inches wide at the base, tapering towards the obtuse apex. My specimens moulded in drying too badly to determine properly. I have followed other collectors in naming the plant, though I am inclined to regard it rather as *R. Patienta* L. The petioles are eaten by the Indians as we use the garden rhubarb.

R. salicifolius Wienm. Bartlett Bay, Alaska.

CHENOPODIACEÆ.

Atripex patula, var. *littoralis* Gray. Harrisburg, Sitka, Fort Wrangel, and other places along the coast.

EMPETRACEÆ.

Empetrum nigrum L. Bartlett Bay, Alaska.

BETULACEÆ.

Alnus rubra Bong. Pyramid Harbor, Kaigan, Alaska.
A. viridis D. C. Harrisburg, Alaska.

I have identified these with much hesitation, regretting on my return home to find my material confined to a single branch of each—the alders of Alaska being worthy, as I now believe, of closer investigation. My botanizing at Harrisburg, and at Kaigan, had to be done beneath an umbrella and in pouring rain—unfavorable for the close study of arborescent growth. If the identifications are correct, the names would deserve to be transposed. The "Harrisburg" species is the one prevalent from there south through British Columbia to the Columbia River, often making a tree I should judge from thirty to forty feet high, and with a trunk occasionally say five to six feet in circumference. The bark of the trunk is a dark reddish brown. The finely serrulate leaves, however, seem precisely like the leaves of *A. viridis*, as I have collected it on the mountains of New Hampshire, and North Carolina, though it is difficult to believe so small a shrub there, should be so fine a tree here.

The alder of Kaigan and Pyramid Harbor is a much larger tree, with a gray and rather smooth bark, even when quite aged. At Pyramid Harbor, a summer settlement for salmon-fishing, Indians had cut some down, and were making canoes—dug-outs—of them. From memory I am sure some of these logs must have been near three feet thick, and thirty feet long—the original height of the tree being probably more than double this. These were on rich bottom lands, near but not on the retreating glacier's track. On the track the same plant apparently made a dense shrubby growth, not taking on at all a tree-like character.

Betula papyracea Ait. Chilcat Inlet, Alaska.

Probably this species; but the leaves seem all cordate and densely woolly. Only a single tree was seen, not mature apparently; but there might have been more, for when found it was approaching midnight and getting almost too dark for further explorations.

SALICACEÆ.

Salix Pallasii And. Bartlett Bay, Alaska.

S. reticulata L. Bartlett Bay, Alaska.

S. Sitchensis Sanson, var. *denudata* And. Bartlett Bay, Alaska.

S. Barclayi And. Bartlett Bay, Alaska.

CUPULIFERÆ.

Quercus Kellogii Newb. Victoria, B. C.

Where exposed to the sea-breezes this seemed but a small "chinquapin"-like bush two or three feet; but only a short distance in the island it becomes a fine timber tree. I believe this is as far north as I saw any species of oak growing.

TAXACEÆ.

Taxus brevifolia Nutt. Victoria, B. C., and Port Townsend, W. T.

A few trees in the vicinity of Victoria, quite as large as some seen in the Calaveras grove of Sequoias, and probably growing further north, though not seen.

CONIFERÆ.

Abies grandis Lindl. Port Townsend, W. T.; Victoria, B. C.

Chamæcyparis Nutkænsis Spach.

Is said by authors to be very abundant from the Columbia River northward through British Columbia and southeastern Alaska. I could not find a single specimen, though continually on the lookout for it, and the owner of a saw-mill at Killisnow Island informed us that the "yellow cedar" was an extremely rare tree in that region.

Picea Sitchensis Carriere (*Abies Menziesii*, of some modern authors).

Common everywhere through British Columbia to the head of Glacier Bay, Alaska, at the latter place forming buried forests near the Muir Glacier and Bartlett Bay. At Kaigan some trees measured twenty-one feet round. It evidently loves atmospheric moisture, and grows on barren rocks, when it is under these atmospheric conditions, quite vigorously; and in this way assists in forming a covering of earth over the rocks. At Kaigan there were trees of many years old, growing from the top of the Indian "totem poles," half as tall as the poles at times.

Pinus contorta Dougl. Chilcat Inlet.

A tree about twenty or thirty feet high, with a rather flattish, spreading head; short ovoid cones, and which are not at all oblique, growing among rocks along the coast.

Also at Bartlett Bay, where it is a stout, very vigorous shrub, branching from the base, without any attempt to make a leader, and much resembling the habit of *Pinus montana* of Europe. The plants were very fertile, the cones being freely scattered among the branches, and cylindrical, without any tendency to obliquity.

Following the Botany of California this would probably be referred to the true *P. contorta*, of Douglas, and the first named to *P. contorta*, var. *Murrayana*, though the characters, as I find them, do not quite agree. I have thought best to leave the determination indefinite.

Tsuga Mertensiana Carriere. Port Townsend, W. T.; Victoria, B. C., and common along the coast. Specimens from Fort Wrangel.

This is the "hemlock" of these parts, and some of the trees at Sitka and Fort Wrangel were as large, at least, as the best specimens of the hemlock found at the East.

Tseudtsuga Douglasii Carriere. Port Townsend, W. T.; Victoria, B. C.; Sitka, Alaska.

Thuja gigantea Nutt. Port Townsend, W. T.; Victoria, B. C.; Kaigan, Alaska. Common along the coast.

This, *Tsuga Mertensiana*, and alders, form most of the arborescent vegetation of the southeastern Alaskan coast.

ORCHIDACEÆ.

Habenaria dilitata Gray. Port Townsend, W. T.

As it seems to me, though it may be a form of *H. leucostachys* Wat.

H. hyperborea. Bartlett Bay, in glacial drift.

Spiranthes Romanzoffiana Cham. Bartlett Bay, Alaska.

IRIDACEÆ.

Sisyrinchium anceps L. Sitka

Not abundant, but probably indigenous.

LILIACEÆ.

Allium acuminatum Hook. Victoria, B. C.

Brodiæa lactea Watson. Port Townsend, W. T.; Victoria, B. C.

B. grandiflora Watson. Victoria, B. C.

An imperfect specimen; probably belongs here.

Prosartes Oregana Watson. Victoria, B. C.

Smilacina bifolia, var. dilitata Wood. Sitka, Fort Wrangel, and many places along the coast, but seldom found in fruit.

The fruiting specimens here from Sitka, have also three, and sometimes four, leaves on the scape.

Streptopus amplexifolius D. C. Fort Wrangel, Alaska.

Tofieldia glutinosa Willd. Bartlett Bay, Alaska.

ARACEÆ.

Lysichiton Camtschatcense Schott. Fort Wrangel, and throughout the coast.

Leaves larger, narrower and much more glaucous than its analogue, the skunk cabbage of the Eastern States.

Two young deer, about a year old, were captured while attempting to swim across a four-mile stretch of an arm of the sea, and brought on board the steamer, the captain intending to take them to San Francisco. They took well to their imprisonment; but after some time, the ship's boat brought back a lot of these leaves. I remarked to the captain that the acrid leaves would probably be fatal to the animals, but he remarked that they would not eat them so freely if injurious, and they were fed continuously for several days on them, when one died. The captain's idea was that it died of sea-sickness. It had been very rough the night it died. The other one finally recovered.

NAIDACEÆ.

Triglochin maritimum L. Fort Wrangel, Alaska.

T. palustre L. Bartlett Bay, Alaska.

JUNCACEÆ.

Juncus arcticus Willd. Bartlett Bay, Alaska.

J. Balticus Dethard. Fort Wrangel.

Varies in size in different localities.

J. bufonius L. Sitka, Alaska.

J. filiformis L. Astoria, Or.

J. xiphioides Meyer. Fort Wrangel, Alaska.

Luzula campestris D. C. Sitka, Alaska.

L. spadicea, var. *parviflora* Meyer. Fort Wrangel, Alaska.

CYPERACEÆ.

Carex cryptocarpa. Alaska.

C. muricata Linn. Alaska.

C. undetermined. Alaska.

C. undetermined. Alaska.

Eriophorum gracile Koch. Fort Wrangel, Alaska.

Scirpus pungens Vahl. Fort Wrangel, Alaska.

GRAMINEÆ.

(Identified by F. Lamson Scribner.)

Agrostis alba var. *scaberrima*. Bartlett Bay, Alaska.

A. canina, var. Sitka, Alaska.

A. exarata Trin. Sitka, Alaska.

A. vulgaris Nutt. Sitka, Alaska.

Aira caryophyllea L. Victoria, B. C.

Alopecurus aristulatus Mx. Departure Bay, B. C.

Atropus angustata Ledeb. Sitka, Alaska.

Deschampsia elongata. Departure Bay, B. C.

Deyeuxia Langsdorffii Kunth. Fort Wrangel, Alaska.

Elymus Sibiricus L. Departure Bay, B. C.

This seemed so great a favorite with the birds that it was with difficulty I got a few complete spikes for herbarium.

Elymus mollis Trin. Pyramid Harbor, Alaska.

This is a broad-leaved, strong-growing kind, growing along sandy shores as *E. arenarius* does in other places; and not uncommon along the coast.

Festuca ovina, var. *duriuscula.* Bartlett Bay, Alaska.

Festuca ovina, var. *duriuscula.* Sitka, Alaska.

The last spike much more decompound.

Glyceria angustata Griesb. Idaho Inlet, Cross Sound, Alaska.

Mr. Scribner refers it to Griesbach's species without deciding whether or not it should be united with *G. distans* G. The plant was growing in mud overflowed at high-tide, and formed a dense carpet of green grass on the mud. The growth is about four to six inches.

G. distans Gr. Fort Wrangel, Alaska.

G. pauciflora Presl. Sitka, Alaska.

Hierochlœ borealis L. Bartlett Bay, Alaska.

Holcus lanatus L. Astoria, Or.

Only one plant noted, on the hills along the river, about four miles above Astoria. *Pyrethrum Parthenium* was also collected within a few feet of it.

Hordeum nodosum L. Bartlett Bay, Fort Wrangel, Alaska.

Phleum alpinum L. Bartlett Bay, Alaska.

P. pratense L. Sitka, Alaska.

Common in grassy places; but possibly introduced.

Poa pratensis L. Bartlett Bay, Alaska.

Both the green and the bronzy forms.

Trisetum spicatum, var. *molle,* Gray. Bartlett Bay, Alaska.

EQUISETACEÆ.

Equisetum variegatum Sch. Bartlett Bay, Alaska.

FILICES.

Adiantum pedatum L. Harrisburg, Killisnow Island, Alaska.

Pinnules more deeply lobed, and the divisions of the stipe more elongated and slender than the Eastern form.

Aspidium munitum Kaul. Departure Bay, B. C.

Very variable in size; but always seeming very fertile.

A. aculeatum Swartz. Harrisburg, Alaska.

Cryptogramme acrostichoides R. Br. Bartlett Bay, Alaska.

Very vigorous, fronds 9 to 10 inches.

Cystopteris bulbifera. Pyramid Harbor, Alaska.

Cystopteris fragilis. Pyramid Harbor, Alaska.

Lomaria Spicant Desveaux. Sitka, Alaska.

Phegopteris Dryopteris, Fee. Fort Wrangel, Alaska.

Phegopteris polypoides Fee. Bartlett Bay, Alaska.

Polypodium falcatum Kellogg. Killisnow Island, Alaska.

Polypodium vulgare L. Killisnow Island.

Pteris aquilina L. Victoria, B. C. Fort Wrangel, Alaska.

LYCOPODIACEÆ.

Lycopodium annotinum L. Killisnow Island, Alaska.

NOTES ON SPECIES OF FISHES IMPROPERLY ASCRIBED TO THE FAUNA OF NORTH AMERICA.

BY DAVID S. JORDAN.

The study of the geographical description of species is impossible without a correct knowledge of the species themselves and of the localities whence specimens have been obtained. Every attempt at generalization in this field has been more or less vitiated by errors of identification or errors as to locality. No accident, unfortunately, is more common in museums, or in private collections, than the mixing of specimens from different localities, and the false records arising from such confusion have a wonderful vitality. The early writers in systematic zoölogy had no conception of the problems of geographical distribution, and many modern writers have a very low estimate of the importance of accuracy in that regard.

It is certain that numerous species of fishes have been ascribed on erroneous information to the waters of the United States, by writers of authority. Such species should of course be dropped from the lists. Nor should any species be retained in regard to which any serious doubt exists. It is manifestly better that a chance visitor to our shores should be erroneously omitted, than that a species which has never been taken should be improperly inserted.

I give here the names of 35 species which should, in my opinion, be dropped from our lists of species inhabiting the waters of North America, north of the Tropic of Cancer. Most of these are admitted in Jordan and Gilbert's Synopsis of the Fishes of North America, but many of them are repudiated in the addenda to this work. I omit several species already expunged by earlier writers, and include only those which have lately had some degree of currency. I divide these into two series, as to whether the error is one as to locality or as to identification.

a. Species erroneously recorded as to locality.

1. **Carcharias isodon** Müller and Henle.

Originally described from a specimen from unknown locality collected by Milbert. As Milbert made some collections in New York, it has been assumed that this specimen came from New York, and that Mitchill's *Squalus punctatus* is the same species.

But Mitchill's shark was probably the *Carcharias terræ-novæ* of Richardson, and no recent collector has found *C. isodon* on our coasts.

2. **Carcharias punctatus** (Mitch.).

Described by Richardson as *C. terræ-novæ*, from a specimen brought by Audubon from Newfoundland. *Scorpæna bufo* C. and V. (= *S. plumieri* Bloch) and *Malthe cubifrons* Rich. (= *M. vespertilio*, var. *radiata* Mitch.) were in the same collection. Audubon collected in Southern Florida also: his accuracy in regard to localities is not above suspicion, and the three species in question belong to the fauna of the Florida Coast. There is not the slightest probability that any of the three came from the northern coast.

3. **Dules auriga** Cuv. and Val.

A South American fish, introduced in our lists by De Kay, from a specimen seen "several years ago in the collection of Mr. Hamilton, who informed me that it had been taken in the harbor of New York." This is not probable.

4. **Paranthias furcifer** (Cuv. and Val.).

(*Brachyrhinus creolus* [C. and V.] Gill.)

Described by De Kay under the name of *Corvina oxyptera*, from an old specimen in the cabinet of the New York Lyceum, "obtained from the adjacent coast." The specimen was probably from the West Indies, where the species is not uncommon.

5. **Epinephelus niveatus** Cuv. and Val.

A young specimen belonging (according to Goode and Bean) to this species, was described by Professor Gill (Proc. Ac. Nat. Sci. Phila., 1861, 98) under the name of *Hyporthodus flavicauda*. This specimen belonged to a collection sent to the Academy at Philadelphia by Mr. Samuel Powell, of Newport, Rhode Island. A list of this collection is given by Professor Cope (Proc. Ac. Nat. Sci. Phila., 1870, 118). Eleven species are included in it. All are represented by young specimens, which had probably not strayed far from the place where they were hatched. All of them are of tropical types; six of them have not since been found in the United States, and only two (*Caranx setipinnis* Mitch. = *Vomer curtus* Cope, and *Pseudopriacanthus altus* Gill) have since been seen on the New England Coast; while three others (*Hemi-*

rhamphus unifasciatus Ranz., *Glyphidodon saxatilis* L., and *Tetrodon testudineus* L.) are found on our Florida Coast.

Certainly it is very improbable that this collection was made at Newport, and I think that until good evidence appears that such was the case, the entire list should be erased.

6. **Polyprion americanus** (Bloch and Schneider).
(*Polyprion cernium* Val.)

Dr. Day says (Fish. Gt. Britain, etc., p. 17) of this species: "Forster recorded it from Queen Charlotte's Island on the Western shore of North America." The "Queen Charlotte's Island" referred to by Forster, lies, if I am not mistaken, in the neighborhood of New Zealand, and his *Perca prognatha* or *Epinephelus oxygenios* Bloch and Schneider is probably a species of *Stereolepis;* at any rate, not a *Polyprion; P. americanus*, however, has been taken in deep water off our Atlantic Coast.

7. **Rhypticus nigripinnis** Gill.
(*Promicropterus decoratus* Gill.)

A species belonging to the Pacific Coast of Tropical America. A specimen in the Powell collection above noticed, was identified with it by Professor Cope.

8. **Apogon americanus** (Castelnau).

A specimen in the Powell collection was identified with this species by Professor Cope. Castelnau's type came from South America. It was very imperfectly described and is in bad condition. Vaillant and Bocourt have identified the specimen somewhat doubtfully with *Apogon dovii*, a Panama species; what Professor Cope had is therefore very doubtful.

9. **Chætodon maculocinctus** (Gill).

Described from a very young fish in the Powell collection, and not since recognized.

10. **Scorpæna porcus** L.

A specimen in the Museum at Paris, said to have been brought by Milbert from New York, which is very improbable.

11. **Trigla cuculus** L.

A specimen in Paris, collected by Milbert with the preceding species. Both belong to the fauna of Southern Europe.

12. **Balistes powelli** Cope.

Described from the Powell collection; perhaps a young specimen of *Balistes carolinensis* Gmelin (= *B. capriscus* Gmelin).

13. **Tetrodon trichocephalus** Cope.

Described from the Powell collection; not since recognized.

14. **Ranzania truncata** (Retz).

Given in Jordan and Gilbert's Synopsis Fish. N. A. as "occasional off our Atlantic Coast." The specimen in question came from the Bermudas.

b. Species admitted through erroneons identifications.

1. **Galeus galeus** (L.).

Recorded from California by Dr. Günther and later by Jordan and Gilbert. Our specimens are since recognized as belonging to a distinct species, *G. zyopterus* J. and G.

2. **Carcharias plumbeus** Nardo.

(*Carcharias milberti* Val.)

One of the types of *Carcharias milberti* Val. came from Milbert's collection, "New York." The others were from the Mediterranean and belongs to the previously described *C. plumbeus.* Milbert's specimen was probably either *C. cœruleus*, or else from some other locality. In any event, *C. milberti* Val. should not have a place in our lists.

3. **Carcharias lamia** Risso.

First ascribed to our fauna by Putnam, from a tooth found on St. George's Banks; afterwards by Jordan and Gilbert from specimens taken at San Diego, California. The latter belong to distinct species (*C. lamiella* J. and G.). The species, however, occurs in abundance about the Florida Keys, and it should be retained in our lists.

4. **Isurus glaucus** Müller and Henle.

Our fish does not agree well with Müller and Henle's account of the East Indian *glaucus.* It is probably distinct and should stand as *I. dekayi* Gill.

5. **Isurus spollanzani** Raf.

Certainly not yet positively known from our coast. De Kay's *Lamna punctata* is *Isurus dekayi.* Storer's *Lamna punctata* is *Lamna cornubica.*

6. **Heptranchias indicus** (Cuvier).

The Californian species, *H. maculatus* Ayres, has been erroneously confounded with this East Indian shark.

7. **Pristis pristis** (L.).

There is no evidence of the occurrence of this species (*P. antiquorum* Latham) in American waters. All Atlantic specimens studied belong to *P. pectinatus* Latham; those from Panama to *P. perroteti* Val.

8. **Lepidosteus tristœchus** (Bloch).

Our Alligator Gar appears to be somewhat different from this Cuban species. Its oldest name is *Lepidosteus spatula* Lac.

9. **Muræna afra** Bloch.

The American species thus called by Günther and by Jordan and Gilbert does not appear to be identical with the African species called *Gymnothorax afer* by Bloch, which is described as "brunneo alboque marmorato." Our species should apparently stand as *Muræna funebris* (Ranzani). *Muræna infernalis* Poey is the same species.

10. **Ophichthys punctifer** Kaup.

The specimens from Pensacola recorded as *O. punctifer* or *mordax* Poey, belong to the species called *Ophichthys schneideri* by Steindachner. Possibly all three are identical.

11. **Sphyræna sphyræna** (L.).

Our small Northern Barracuda has been identified with this European species (*Sphyræna spet* Lac.) by Günther and later by Jordan and Gilbert. It is, however, I think, specifically distinct and should stand as *Sphyræna borealis* De Kay, as has been already indicated by Goode and Bean, and by Meek and Newland.

12. **Trachynotus goreënsis** Cuv. and Val.

The large pompano or "permit" of the Florida Keys and West Indies has been identified by Goode and Bean, following Dr. Günther, with the African fish indicated as *Trachynotus goreënsis*, by Cuvier and Valenciennes. There is, however, little reason for thinking this identification correct. On the other hand the young of the American "Permit" have been described by Professor Gill under the names *Trachynotus rhodopus* and *Trachynotus nasutus*. It should therefore stand as *Trachynotus rhodopus*, as lately noted by Meek and Goss. *Trachynotus carolinus* of Poey's memoirs is *T. rhodopus*. *T. kennedyi* Steindachner is a different species.

13. **Coryphæna equisetis** L.

All the dolphins thus far definitely known from our coast, under whatever names described, belong to *Coryphæna hippurus* L. The occurrence of *C. equisetis* is yet to be proven, although not improbable.

14. **Epinephelus acutirostris** (Cuv. and Val.).

It is probable that the specimen of this species, mentioned by Cuvier and Valenciennes as having been sent to Paris from Charleston by Holbrook, belongs to *Epinephelus microlepis* (Goode and Bean). This species differs from *E. acutirostris* in the much smaller scales, as well as in other respects. The specimens in the National Museum called *Trisotropis brunneus* Poey, by Goode and Bean, and afterwards made the types of *Trisotropis stomias* Goode and Bean, belong also to *E. microlepis*. The real *Trisotropis brunneus* Poey abounds, however, about the Florida reefs.

15. **Sciæna stellifera** (Bloch).

Sciæna lanceolata (Holbrook), the species found on our Carolina coast, is not identical with either the *Sc. stellifera* (or *trispinosa*) of Günther or of Steindachner. What species is the original of Bloch is certainly doubtful, as at least nine species of this type ("*Stelliferus*") occur in the waters of Tropical America, and Bloch's specimen was said to have come from Africa.

16. **Holacanthus tricolor** Bloch.

Inserted by Jordan and Gilbert (Synopsis, p. 941) as from the Florida Keys, on the statement of a collector. The specimens in question belong to *Pomacanthus aureus.*

17. **Pomacanthus arcuatus** L.

The specimen in the National Museum from Garden Key, Florida, referred to this species, belong to *Pomacanthus aureus* (Bloch). The latter species is abundant about the Florida Keys, but *P. arcuatus* is yet to be taken in our waters.

18. **Acanthurus phlebotomus** Cuv. and Val.

This is another species sent from New York to Paris, by that remarkable collector, Milbert. It is a West Indian species, not yet known from our coasts, unless it be identical with *A. chirurgus*, which is probable. The original *Chætodon nigricans* of L. was based on an old world specimen, and neither this nor any other American species should be called *Acanthurus nigricans.*

The only species of *Acanthurus* yet definitely known from the American coasts are *A. chirurgus*, *A. tractus* and *A. cœruleus*.

19. **Cottus bubalis** L.

This species has been ascribed to the fauna of Greenland, but, according to Lütken, it has not yet been found in that region.

20. **Agonus cataphractus** L.

Erroneously ascribed to Greenland, *A. decagonus* Bloch having been mistaken for it.

21. **Prionotus punctatus** (Bloch).

A common West Indian species, appearing in nearly all of our catalogues as a fish of our South Atlantic Coast. But I have seen no specimens from any point north of Cuba. It is probable that the very different species, *Prionotus scitulus* Jor. and Gilb., has been repeatedly recorded as *P. punctatus*.

22. **Anoplarchus alectrolophus** (Pallas).

Described from the Gulf of Penshin, and therefore not yet definitely known from Alaska.

23. **Blennius fucorum** Cuv. and Val.

Specimens of a Blenny found in the fucus in the open sea, outside of NewYork harbor, were referred by De Kay to this species. De Kay's description is taken from Cuvier and Valenciennes, and no evidence of the correctness of this identification appears. In local lists, *Isesthes punctatus* Wood has appeared occasionally as *Blennius fucorum*.

24. **Hippocampus hippocampus** L.

(*H. heptagonus* Raf.; *H. antiquorum* Leach.)

A sea-horse from St. George's Bank has been identified with this European species by Mr. Goode. His description does not agree well with my European specimens, and I think that his fish must belong either to *H. hudsonius* or to some species as yet undescribed.

NOTES ON TERTIARY SHELLS.

BY OTTO MEYER.

In the Proceedings of the Academy of Natural Sciences, Phila., 1879, pp. 217–225, A. Heilprin gave in an essay, well worthy of perusal, a review of those species of the American Tertiary which had been hitherto compared and identified with European ones, and then identifies the following:[1]—

Cardita imbricata Lam. = *Cardita rotunda* Lea.
Cardita planicosta Lam. = *Cardita planicosta* Lam. (Conr.).
Corbis lamellosa Lam. = *Corbis lirata* Conr.
Trochita trochiformis Lam. = *Trochita trochiformis* Lea.
Cypræa elegans Defr. = *Cypraedia fenestralis* Conr.
Actæon simulatus Sow. = *Tornatella bella* Conr.
Niso terebellatus Lam. = *Pasithea umbilicata* Lea.

I have seen and examined many American species in the museums of New York and New Haven, but my observations are chiefly derived from material of my own collection, consisting of several hundred German Oligocene species in addition to numerous

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[1] Here are omitted all identifications, where Heilprin has any doubt, or which are not obtained by a direct comparison of specimens; of such are the following:—

Ostrea divaricata Lea, compared with *Ostrea flabellula* Lam.
Pecten Deshayesi Lea, " " *Pecten opercularis* Lam.
Cardium Nicolleti Conr., " " *Cardium semigranulatum* Sow.
Corbula oniscus Conr., " " *Corbula rugosa* Lam.
Cylichna galba Conr., " " *Bulla Brocchi* Bronn.
Tornatella pomilia Conr., " " *Tornatella inflata* Féruss.
Pyrula penita Conr., " " *Pyrula nexilis* Lam.
Cancellaria tortiplica Conr., compared with *Cancellaria evulsa* Brand.
Sigaretus declivus Conr., *Sigaretus bilix* Conr., " " *Sigaretus canaliculatus* Sow
Solarium ornatum Lea, compared with *Solarium canaliculatum* Lam.
Pleurotoma nodo-carinata Gabb, compared with *Pleurotoma denticula* Bast.
Mesostoma rugosa Heilpr., compared with *Mesostoma grata* Desh.
Melania Claibornensis Heilpr., " " *Melania mixta* Desh.

American ones. From these examinations I have been able to identify the following additional species :—

1. **Cerithium trilineatum** Phil.

? 1832. *Cerithium turellum* Grat.
Grateloup, Tabl. des Coq. foss. du bassin de l'Ad. Act. Linn., v, 5. p. 277.

1836. *Cerithium trilineatum* Phil.
R. A. Philippi, Enumeratio molluscorum Siciliæ, etc., vol. i, p. 195, tab. 11, fig. 13.

1840. *Cerithium terebralis* Ad.
C. B. Adams, Descr. of thirteen new spec. of New England shells. Boston Journ. Nat. Hist., vol. iii, p. 320, tab. 3, fig. 7.

1841. *Terebra constricta* H. C. Lea.
H. C. Lea, Descr. of some new spec. of foss. shells from the Eocene of Claiborne, Ala.; Am. Journ. Sc. a. Arts, vol. xi, p. 100, tab. 1, fig. 18, read Oct. 1840, publ. 1841.

1843. *Cerithium trilineatum* Phil.
Philippi, Beitr. z. Kenntn. d. Tertiaerverstein. d. nordwestl. Deutschlands, p. 23, p. 56, p. 75.

1848 *Cerithium trilineatum* Phil.
Wood, Crag Mollusca, vol. i, p. 70, tab. 8, fig. 4 *a*.

1856. *Cerithium trilineatum* Phil.
Hœrnes, fossil. Moll. d. Tertiaerbeck. v. Wien, vol. i, p. 413, tab. 42, fig. 19.

1864. *Cerithium trilineatum* Phil.
Speyer, Tertiaerfauna v. Sœllingen, Palœontographica, vol. ix, p. 32.

1866. *Cerithium mundulum* Desh.
Deshayes, Anim. s. vertèb. du bassin de Paris, vol. iii, p. 222, tab. 79, fig. 31, 32.

1867. *Cerithium Sandbergeri* (v Koenen non Desh.).
v. Koenen, Marine Mitteloligocæn v. Norddeutschland, Palæontogr., xvi, p. 104.

1883. *Cerithium Sandbergeri* (Meyer non Desh.).
O Meyer, Beitr. z. Kenntn. der Maerk. Rupelthons, Ber. d. Senckenb. Naturforsch. Ges., Frankfurt a. M., 1882–1883, p. 261.

1883. *Cerithium Meyeri* (Boettg.) [no description given].
Lepsius, Mainzer Becken, p. 50.

1883. *Cerithiopsis Meyeri* Boettg.; *n. sp.*
Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg, 1883, p. 247.

——— *Terebra trilirata* Conrad. When and where?

Having seen *Cerithium trilineatum* Phil. occurring in the European and American older and newer Tertiary, as well as in the Mediterranean, I sought for it among the recent shells of the American Eastern coast, and have received, through the kindness

of Professor Verrill, specimens of *Cer. terebralis* Ad., which species was the looked-for identical one.

The description and figure of *Terebra constricta* H. C. Lea are poor, but there is no doubt about this determination of my specimens from Claiborne, which are quite identical with the German ones.

Among the synonyma, *Cer. mundulum* Desh. is given, although I have no specimens of this species; but I cannot find any difference to distinguish it from the figure and description given by Deshayes of *Cer. trilineatum*, and, as such a competent observer as Speyer has said the same, I do not think I have made a mistake.

Cer. trilineatum occurs in the American Miocene. I received one specimen of it labeled: "*Terebra trilirata* Conr.," but I could not find this name in any of Conrad's papers. Professor Heilprin writes to me: "Possibly it is one of the numerous forms that Conrad named without description."

If *Cer. trilineatum* Phil. should be identical with *Cer. turellum* Grat., of which I have no specimens, the latter name would have the priority.

Cer. trilineatum Phil. is generally distributed in the older and later Tertiary and also at the present time on both sides of the Atlantic.

2. **Pleurotoma denticula Bast.**

1825. Basterot, Descr. Géol. du bassin tert. sud-ouest de la France, p. 63, tab. 3, fig. 12.

1833. *Pleurotoma Baumonti* Lea.
I. Lea, Contrib. to Geology, p. 134, tab. 4, fig. 127.

1844. *Pleurotoma denticula* Bast.
Nyst. Descr. des. Coq. foss. de la Belg., p. 526, tab. 44, fig. 2.

1860. *Turris nodo-carinata* Gabb, fide Heilpr.
Gabb, Descr. of new spec. of Am. Tert. a. Cret. foss.; Journ. Ac. Nat. Sc. Philad., vol. iv, 2d series, p. 379, tab. 67, fig. 13.

1861. *Pleurotoma denticula* Bast.
Edwards, Monogr. of Brit. Eocene, p. 286, tab. 30, fig. 7 *a–h*.

1867. *Pleurotoma denticula* Bast.
v. Koenen, Mar. Mitteloligocæn, p. 89.

1879. *Pleurotoma denticula* Bast.
Heilprin, Proc. Ac. Nat. Sc. Philad., p. 214, tab. 13, fig. 10.

The last named author writes that he found *Pleur. denticula* Bast in Claiborne sand. He figures a specimen without the upper pa

of the spire and determined this species from descriptions and figures of European specimens. It is here only necessary to say that I concur in Heilprin's determination after having compared perfect shells from Claiborne with perfect German ones (Sternberger Oligocene). In my opinion a direct comparison of specimens is *conditio sine qua non* in the identification of species from both sides of the Atlantic.

The Claiborne specimens are apparently *Pleur. Baumonti* Lea, but the name of Basterot has the priority.

Pleur. denticula Bast., which occurs also in Italy, seems to be widely spread in the Tertiary.

3. Pleurotoma Volgeri Phil.

? 1804. *Pleurotoma terebralis* Lamarck.
Deshayes, Coq. foss. 1824-37, vol. ii, p. 455, tab. 62, fig. 14-16.

1846. *Pleurotoma Volgeri* Phil.
Philippi, Verzeich. d. in d. Geg. v. Magdeburg aufgef. Tertiaerverstein., Palæontographica, i, Aug. 1846, p. 69, tab. 10 *a*, fig. 2.

1847. *Pleurotoma cristata* Conr.
Conrad, Proc. Ac. Nat. Sc. Philad., iii, p. 284 (no figure).

1848. *Pleurotoma cristata* Conr.
Conrad, Journ. Ac. Nat. Sc. Philad., i, 2d series, p. 115, tab. 11, fig. 20.

1860. *Turris cristata* Conr.
Gabb, Journ. Ac. Nat. Sc. Philad., vol. ix, 2d series, p. 378, tab. 67, fig. 12, non fig. 8.

? 1861. *Pleurotoma Volgeri* Phil.
Edwards, Monogr. of the Eocene Moll. of England, p. 275, tab. 30, fig. 15 *a*, *b*, non fig. 13. (Publ. Paleontogr. Soc. London, issued as volume for 1858, publ. 1861.)

? 1861. *Pleurotoma terebralis* Lam.
Edwards, ibid., p. 233, tab. 27, fig. 10 *a-k*.

1865. *Cochlespira engonata* Conr.
Conrad, Am. Journ. of Conchology, i, p. 142, figure in the same volume, tab. 21, fig. 12.

1865. *Cochlespira bella* Conr.
Conrad, ibid., p. 210, tab. 21, fig. 6.

1867. *Pleurotoma Volgeri* Phil.
v. Koenen, Mar. Mitteloligocæn, Palæntogr., xvi, p. 92.

1867. *Pleurotoma Volgeri* Phil.
Speyer, Conchyl. d. Casseler Tertiaers, Palæontogr., xvi, p. 193, tab. 19, fig. 12 *a*, *b*.

1872. *Pleurotoma terebralis* Lam.
Koch und Wiechmann, Die Molluskenfauna des Sternberger Gesteins in Mecklenburg, p. 66.

With the German specimens of the Maerkische Rupelthon and the Sternberger Oligocene, two specimens from Ashley, S. C., one from the upper strata of Claiborne (which are apparently Oligocene), and one specimen of typical *Pleurot. cristata* Conr. from Vicksburg were compared. The latter was obtained for comparison through the kindness of Professor Heilprin of Philadelphia.

Both German and American forms vary in slenderness; *Cochlespira engonata* Conr. is apparently one of the shorter specimens. In the American forms the number and sculpture of the revolving lines seem to be generally more developed, but these vary too. Conrad says: "*Cochlesp. bella* differs from *C. cristata* in having fewer and coarser lines and a more prominent carina."

What Edwards figures as *Pleur. Volgeri* Phil. looks quite different. Much more like seems to be his *Pl. terebralis* Lam., of which he describes six varieties. The opinions of the German authors as to the identity of *P. Volgeri* Phila. and *P. terebralis* Lam. are varying. I am greatly inclined toward uniting them, but for want of sufficient material prefer withholding a positive opinion on this point.

4. Saxicava arctica L.

1766. *Mya arctica* L.
Linn., Syst. Nat. ed. 12, p. 1113.

1836. *Saxicava arctica* L.
Philippi, Enum. Mollusc. Sicil., etc., i, p. 20, tab. 3, fig. 3.

1838. *Saxicava bilineata* Conr.
Conrad, Medial Tertiary or Miocene fossils of the U. S., p. 18, tab. 10, fig. 4.

1844. *Saxicava arctica* L.
Nyst., Coq. foss. Belg., p. 95, tab. 3, fig. 15 *a-c*.

1846. *Saxicava arctica* L.
Lovén, Ind. moll. Scand., p. 40.

1848. *Saxicava arctica* L.
S. V. Wood, Crag. Moll., ii, p. 287, tab. 29, fig. 4 *a*, *b*.

1856. *Saxicava arctica* L.
Hoernes, Wiener Becken, p. 24, tab. 3, fig. 1, 3, 4.

? 1860. *Saxicava Jeurensis* Desh.
Deshayes, Anim. s. vertèb., i, p. 170, tab. 10, fig. 18, 19, 20.

1863. *Saxicava bicristata* Sandb.
Sandberger, Conchyl. d. Mainzer Beckens, p. 277, tab. 21, fig. 6.

1864. *Saxicava bicristata* Sandb.
Speyer, Tertiaerfauna v. Soellingen, Palæontogr., ix, p. 48.

1867. *Saxicava arctica* L.
Weinkauff, Conchyl. d. Mittelmeeres, i, p. 20.

1868. *Saxicava arctica* L.
v. Koenen, Marin. Mitteloligocæn, 2d part, Palæontogr., xvi, p. 266.

Two specimens of *Saxicava bilineata* Conr. from the American Miocene prove to be the same variety as *S. bicristata* Sandb.

Wood has already said in 1848 (Crag. Moll. p. 288): "*Saxicava bilineata* Conr. is probably another variety of this species" (*S. arctica*).

I cannot see in the figure of *S. Jeurensis* Desh. any difference from our species. V. Koenen seems to be of the same opinion.

Saxicava arctica L. seems to be generally distributed in the older and later Tertiary and in the present time on both sides of the Atlantic.

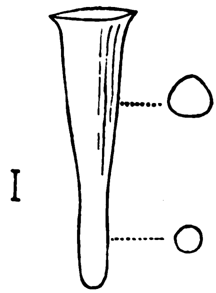
New species were found by me in Claiborne sand, belonging to the American Museum of Natural History in New York, and which had been examined several times before. Afterwards I received sand from Claiborne myself and found most of these species again, as well as others that are new. Only the three following species, however, are published here, chiefly because the state of the literature on North American Tertiary invertebrates makes it almost impossible to determine with certainty new species and to find and to describe the differences from similar forms, already named.*

* In White's Bibliography there are given nearly seventy papers of the main author of this literature, T. A. Conrad, containing notes on American Tertiary mollusks; and even this list is not complete. Conrad's description and figures are mostly poor or very poor. He published a great many fossils without figures, many without localities, and not a few without giving even the formation; I have also found one without a name (Proc. Ac. Phil., 1862, p. 288). In his two check-lists of the older Tertiary (1865 and 1866) he ignores the species of H. C. Lea, and does not give an account even of all his own. Having a tendency to describe a variety as a new species and a species as a new genus, he found, of course, that not only the Miocene species are all different from the Eocene ones, but that even the groups of the Am. Eocene "hold few, if any, species in common."

PTEROPODA.

Tibiella Marshi (nov. gen. et nov. spec.)*

Shell thin, tubular. The closed end little convex. The lower part, about one third of the whole length, of a circular section, then by tapering a little forming a kind of a neck, above which the shell is of a rounded trigonal section. Aperture dilated.



Length, $3\frac{1}{2}$ mm.

Locality.—Eocene sand from Claiborne, Ala.

Remarks.—If the figured specimen is adult, in the young ones the apex may be perhaps acute and afterwards partitioned off, as in the genus *Triptera* Quoy et Gaimard (*Cuviera* Rang).

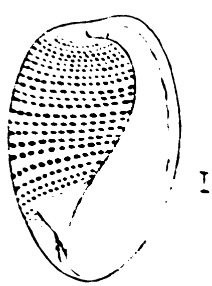
This genus is allied to *Tibiella*, and the latter is perhaps a subgenus of the former.

Pteropoda are described from the Miocene and Oligocene, but as far as I am acquainted with the literature this is the first Pteropod from the Eocene.

OPISTHOBRANCHIATÆ.

Bulla biumbilicata (nov. sp.).

Shell small, moderately thick, oval, the upper end obliquely truncated and umbilicated, the lower end somewhat tapering. Last whorl most prominent at about one-third of the whole length. Outer lip? Inner lip below with a large trigonal thin callus, which covers a minute umbilicus. Surface with revolving lines, disappearing at both ends and generally most distant from each other at about the middle of the shell. A strong magnifying glass shows that these lines are furrows, looking like pearl-ribbons, which structure causes the surface to look at some places as if it were minutely longitudinally costated.



Length, $2\frac{1}{2}$ mm.

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* Genus name from the resemblance to the tibia of mammals. This species is dedicated to Professor Marsh, who enabled me to work by supplying me from his library with a large part of the necessary literature, which I could not get elsewhere.

Locality.—Eocene sand from Claiborne, Ala.

Remarks.—One specimen, the outer lip of which is not quite perfect.

An allied form seems to be *Bulla Horni* Gabb, of Fort Téjon, Cal. (Gabb, Paleontology of California, vol. i, 1864, p. 143 [non p. 140], tab. 29, fig. 235), but this species is larger, thin, has no callus and seems to differ besides in form and sculpture. Gabb says: "Surface marked by numerous, very fine, impressed revolving lines."

Very similar is *Bulla ovulata* Lam. (Deshayes, Coq. foss. des env. de Paris, vol. ii, p. 39, tab. 5, fig. 13, 14, 15), but without callus.

Bulla subspissa Conr. (Proc. Ac. Philad., vol. iii, 1846, p. 20, tab. 1, fig. 29) from the Miocene of Calvert Cliffs, Md., seems to be of smooth surface; at least Conrad does not say anything about sculpture.

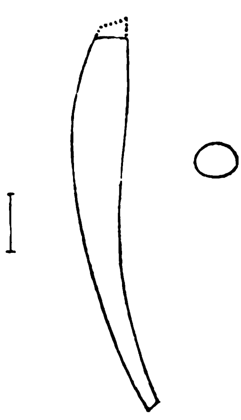
I cannot give the differences from *Bulla petrosa* Conr. (Am. Journ. Sc. a. Arts, vol. ii, 2d series, 1846, p. 399), as Conrad's full description of this shell is the following:—

"*Bulla petrosa.*—Oval, destitute of striæ ?, summit oblique."

GASTEROPODA.

Cadulus depressus (nov. sp.).

Smooth, shining, gently curved, inflation not very prominent. Section everywhere an oval, one side of which is a little flatter than the other. Both ends oblique.



Length, 7 mm.

Locality.—Eocene sand from Claiborne, Ala.

Remarks.—The aperture of the figured specimen is not perfect, but I know that it is of the form indicated in the figure, from other specimens. I have seen altogether about a dozen specimens, and all are everywhere of the same oval section.

There are to be compared three North American species of *Cadulus*:—

1. *Gadus pusillus* Gabb, of the Téjon group, Martinez, Cal. [Cretaceous or Tertiary ?] (Gabb, Paleont. of Cal., vol. i, 1864, p. 139, tab. 21, fig. 99). Gabb says: "section circular."

2. *Dentalium thallus* Conr., of the Miocene of the Southern States (Journ. Ac. Nat. Sc. Philad., vol. vii, 1st series, 1834, p. 142). The specimens of this species in my possession have a circular section, except at the aperture, where they are oval. It is the opinion of Professor Verrill and of myself, that *Cadulus Pandionis* Verrill and Smith (A. E. Verrill, Catal. of Mar. Moll., Transact. Connect. Ac., vol. v, part. 2, 1882, p. 558, tab. 58, fig. 30 *a*) of the western part of the Atlantic is identical with this *Cadulus thallus* Conr., although the latter form has the aperture generally a little more oval. If Jeffreys is right (J. G. Jeffreys, "On the Moll. of the Lightning and Porcupine expedition," part v) in uniting *Cadulus Pandionis* Verrill and Smith, with *Cadulus Olivi* Scacchi from the Pliocene of Sicily, it would result that both late Tertiary species are also identical, and this would be one more instance of a Tertiary species occurring on both sides of the Atlantic.

3. *Ditrupa subcoarcuata* Gabb, Eocene of Texas (Journ. Ac. Nat. Sc. Philad., vol. ix, 2d series, 1860, p. 386, tab. 67, fig. 47). The description of Gabb is the following: "Arcuate, widened in advance of the middle; aperture contracted, circular; surface polished." As Gabb does not say anything about an oval section, but on the contrary writes "aperture circular," it is apparently a different species.

APRIL 1.

The President, Dr. LEIDY, in the chair.

Thirty-one persons present.

A paper entitled "A Review of the American species of the Genus Trachynotus," by Seth E. Meek and David K. Goss, was presented for publication.

APRIL 8.

Rev. HENRY C. McCOOK, D. D., Vice-President, in the chair.

Seventy-three persons present.

A paper entitled "Descriptions of new species of Terrestrial Mollusca of Cuba," by Rafael Arango, was presented for publication.

Dr. Daniel G. Brinton was inaugurated as Professor of Ethnology and Archæology, and delivered a lecture on "Prehistoric Man in America."

APRIL 15.

Mr. CHAS. P. PEROT in the chair.

Twenty-four persons present.

A paper entitled "A Review of the American species of the Genus Synodus," by Seth E. Meek, was presented for publication.

On the Process of Digestion in Salpa.—Dr. CH. S. DOLLEY remarked that preliminary to giving the full results of a somewhat extended study of the histology of *Salpa*, he desired to make a few remarks in reference to certain statements recently made by Dr. A. Korotneff of Moscow,[1] which he considered erroneous in so far as they indicate the presence of a huge amœboid cell or plasmodium, in the œsophagus and stomach of *Salpa*, functioning as a digestive organ. Dr. Korotneff describes this cell as arising from the repeated division of a single cell which early in the life-history of the animal is separated from the intestinal wall. This giant-cell or plasmodium, acting like a huge rhizopod, carries on

[1] *Ueber die Knospung der Anchinia* in Zeitschr. f. wiss. Zoologie. Bd. 40, Hft. i, 1884.

a form of parenchymatous digestion of the food taken by the animal, passing the resulting chyle into the walls of the intestine by means of its pseudopodia. Now by reference to an article by Metschnikoff "On Intracellular Digestion in Invertebrates" (in the Quarterly Journal of Microscopical Science for January, 1884), it will be seen that such a form as Korotneff describes has never been met with, and his description stands alone and anomalous, both as regards the situation and size of the digestive plasmodium, and as to the method of its formation, for in all cases in which such structures have been found in invertebrates, they have always arisen by the fusion of separate cells, not from the repeated division of one cell. In a large number of series of sections made by the new "ribbon" method, the speaker was not only unable to find "the lumen obliterated" by the peculiar structure of the wall of the intestine described by Korotneff, but in a model of the visceral nucleus made after Born's "platten-modillir method" the lumen of the entire intestinal canal is shown to be completely free throughout. He did, however, get sections which gave pictures almost identical with those portrayed by Korotneff, *i. e.* the lumen filled with what he describes as a large nucleated granular cell, containing various food particles, and he could trace this so-called "cell," not only back into "the portion of the intestine lying next to the stomach," but through the rectum into the cloacal chamber, and through the œsophagus into the branchial sac. He accounts for it as follows: The endostyle of *Salpa* has been very carefully studied by Hermann Fol, who demonstrated, by means of carmine suspended in water, that it threw out a constant stream of mucus when excited by the presence of nutritive material in the same water, with a reflex action like a salivary gland. The mucus is, by an arrangement of cilia, spread out like a curtain over the inner surface of the branchial sac, when it acts as a means for catching the food particles from the ingurgitated water. By the action of ciliary bands bordering the groove of the endostyle, the mucus is swept towards the œsophagus, and as it approaches this, it is, by means of the stiff cilia on the sides of the gill, twisted into a thread, and carried by a continuation of the aforesaid bordering bands, through the œsophagus, into the stomach. Now in studying a series of sections of a Salpa which had had abundant food, we find as we approach the œsophagus a mass of material answering to the description of Korotneff's "rhizopod." It takes staining readily and may be traced backward into and through the œsophagus, stomach and intestine. As the sections approach the rectum, however, the mass gradually ceases to take staining, and is much more distinctly marked out from the intestinal wall, having had all the organic matter digested out, and consisting only of the inorganic remains, which do not stain. The alimentary matter of Salpæ is composed of animal and vegetal elements in nearly equal proportions, and the microscope reveals the car-

careous shells of Foraminifera, the beautifully sculptured frustules of Diatomaceæ, keen siliceous needles, and the sharp armatures of minute crustacea.

In the fore-part of the intestinal canal, the food mass, staining almost as readily as the wall of the gut itself, seems to merge into the ill-defined epithelium of the latter, and it is scarcely possible to say where the food-bearing mucous thread ceases and the intestinal epithelium begins, especially as this latter has a rugous arrangement. That we have here to do with a form of digestion entirely anomalous and unprecedented, he could not believe, and must beg leave to differ from Dr. Korotneff on this point. Fol and others have recognized the endostyle as a sort of salivary gland, and have traced its food-laden mucous thread into the stomach of the living animal, while the speaker had been able to trace the same thing in well-preserved specimens. He had also several series of sections from animals which must have been without food for some time previous to death, in which the lumen of the intestine is not only free of food, but of any obliterating mass of cells, or plasmodium. The only protoplasmic bodies not food, are certain Gregarina-like organisms adhering to the walls of various parts of the intestine, and which he took to be parasites. These give on section the appearance of the large "scattered cells, entirely free from their surroundings" which Korotneff figures and regards as "analogous to the great stomach-cell of *Anchinia*." The first opportunity would be taken to examine these structures in living Salpæ, but he was now forced to conclude that Dr. Korotneff has endowed the food-bearing mucous thread with a power it does not possess, that *Salpa* does not exhibit any unusual form of intracellular digestion, and that there is no immediate cause on its account for questioning the high genetic place occupied by the Tunicates.

A Preliminary Note on a Reaction common to Peptone and Bile-salts.—Dr. N. A. Randolph stated that if the acid nitrate of mercury (Millon's reagent) be added to a cold aqueous solution of potassium iodide, a *red* precipitate of mercuric iodide always appears. When, however, either peptones or the biliary salts are present in noteworthy amount, the precipitate of nascent mercuric iodide assumes the *yellow* phase. As practically applied, the red may vary from salmon to scarlet, the yellow from pale lemon to orange.

In order to render the test sensitive to the presence of minute quantities of the substances in question, he had found it necessary to limit the amount of potassium iodide employed. Thus to each five cubic centimetres of the suspected fluid—which must be cold and either neutral or faintly acid—are added two drops of a saturated solution of potassium iodide, the two liquids being well mixed. Four or five drops of Millon's reagent are now added, the contents of the vessel thoroughly stirred or shaken. Under these

circumstances the presence of peptone in amounts of less than one part in five thousand is readily shown. By the exercise of great care in the performance of this test he had been enabled to demonstrate the presence of peptone in a solution containing but one part of that body in seventeen thousand parts of water.

The conditions interfering with this reaction are: alkalinity of the fluid examined (readily overcome by neutralization); heat, which has the same influence upon the nascent mercuric iodide as have peptone and the bile-salts; and the presence of certain compounds, as potassium ferrocyanide, which chemically prevent the production of the mercuric iodide.

The reaction just described presents certain advantage from the fact that it is uninfluenced by the bodies usually found in the various organic fluids. It is efficient in the presence of a twenty per cent. solution of serum; the presence of considerable amounts of coagulated albumen and of acid-albumen does not interfere with the test. The following bodies in moderate amount do not affect the reaction: Saliva, Syntonin, Amygdalin, Para-Albumen, Diastase, Kreatin, Leucin, Pyrosin, Mucic Acid, Glucose, Urea, Uric Acid, Nitric, Hydrochloric, Sulphuric and Picric Acids, Glycerine, Alcohol, Atropia Sulphate, Pilocarpin Nitrate, Caffeine, Sodium Carbonate, Ammonium Oxalate, Sodium Phosphate, and Manganese Chloride and Ferric Chloride.

It is obvious that this reaction is useless to the student as an isolated test, inasmuch as it responds to two entirely distinct compounds, but its simplicity and striking colorations give it very considerable value when employed in corroboration of other tests.

Botanical Notes.—At the meeting of the Botanical Section on April 14, Mr. THOMAS MEEHAN made some observations on the following topics:—

Evolution of Heat in Plants.—Referring to some observations of Kerner respecting the thawing out of chambers in ice by living plants in the Alps of Europe, he confirmed them by observations on *Eranthis hyemalis* made during the past winter. At the end of January the plant was in flower after a few warm days, when a driving snow-storm prostrated the little stems, and covered them nearly a foot deep, in which condition they remained till early in March. After they had been three weeks in this condition, the snow was carefully removed, when it was found that the stems had become perfectly erect, and a little chamber in the snow had been thawed out about each flower-stem. There was, however, no other evidence of growth. The few buds which were unopened when the snow came, were still unopened when the snow thawed away, after five weeks' imprisonment; and the idea conveyed was that plants would retain life, without growth, for an indefinite time, when under a low temperature, such as a covering of ice or snow afforded.

Relation of Heat to the Sexes of Flowers.—He referred to his former communications to the Academy regarding his discovery that the male flowers or male organs of flowers entered on active growth at a much lower temperature than excited the female, and exhibited catkins and female flowers of the European hazel-nut, *Corylus Avellana*, just matured April 15, and which, for the first time in several years past, had perfected themselves cotemporaneously. This was the first winter for some time that there had been a uniform low temperature the whole season. In other years a few warm days in winter would advance the male flowers so that they would mature weeks before the female flowers opened, hence the females were generally unfertilized, and there were few or no nuts. Under this law it was evident amentaceous plants could not abound to any great extent in countries or in localities favorable to bringing forward the male flowers before there was steady warmth enough to advance the female. He thought this was likely to be the reason why so many coniferous trees under culture in the vicinity of Philadelphia bore scarcely any fertile seed in their cones—a fact which had often been remarked in connection especially with the Norway spruce. The male flowers would mature before the female had advanced far enough to be receptive of the pollen,

Specific Differences in Picea nigra.—It was regarded as somewhat difficult to distinguish between the red and black spruces. Mr. Meehan exhibited authentic specimens of these and the white spruce, and pointed out the persistent character of the cones in *Picea nigra*, to which his attention had been called by Mr. Robt. Douglas, of Waukegan, Illinois. They were still attached to the branches exhibited.

The Flowers of Platanus.—Having an opportunity to examine a large tree of *Platanus occidentalis*, no exception could be found to the rule that the pedicel proceeded from the third node in the season's growth. It appeared also that in the formation of the pedicel, the growth of the branch was always almost arrested—but not sufficiently so but that it seemed to recover and make a second growth. In many cases the annual growth was completely suppressed, and only a terminal bud was formed just above the axis of the pedicel; but in most cases, another or secondary growth followed the first temporary check and a shoot of several nodes would be formed beyond the point of departure of the pedicel. The same rule prevailed in *Platanus orientalis*.

Variation in Symplocos fœtidus.—Mr. Meehan had made it a point for some years to take, as opportunity offered, some genus of only a single species within a large range of territory, and note the variation therein. In this way we could often see a vast amount of variation, which could not be started by any hybridization with other forms, but which must have been produced by some law of evolution within itself. Even though one might believe himself to be quite familiar with the skunk cabbage,

Symplocos fœtidus, he would be surprised at the great amount of variation it presented, even in a small area, when the variations were looked for by comparison. He had himself seen a plant bearing spathes four inches long, with its next neighbor having one a little over an inch—no larger than a walnut. Some would be globular, some ovate, some linear, some terminating in an abrupt point, others lengthened into a long straight or curved beak. The variations in color were too well known to need more than this bare reference. It was not uncommon to hear variation attributed to environment, by which we are to understand external, and in a measure accidental circumstances. Environment might be led to include some external influence operating on the primary cell, giving birth to the subsequent individual exemplifying the variation.

But in this sense, change by environment would be the merest guess, as no evidence had been offered in support of any special influence then not exerted. At other times no great variation followed, and possibly no one would want to embrace this point in a definition of environment.

Sugar in Cladastris tinctoria.—In Mr. Meehan's garden at Germantown, there were few trees but which exuded sap from wounds made in winter or early spring, but among them all, few bled, as it was termed by horticulturists, more profusely than *Cladastris tinctoria* (*Virgilia lutea* Mx.). The icicles formed from this exuding sap afforded a good opportunity to test the saccharine character of the liquid. During congelation by frost all foreign substances are rejected, and in the formation of the icicle the sugar is pushed forward to the extreme point. The end of an icicle of a sugar maple is its only sweet part, and this was very sweet from the accumulation of the saccharine matter. The end of the icicle from the *Cladastris* was also sweet, though less so than in any other sugar-bearing trees he had observed.

APRIL 22.

The President, Dr. Jos. LEIDY, in the chair.

Twenty-eight persons present.

Vertebrate Fossils from Florida.—Prof. LEIDY directed attention to some fossils, part of a collection recently referred to him for examination by the Smithsonian Institution. They consist of remains mostly of large terrestrial mammals, especially related with forms which now live in the intertropical portions of the old world. Obtained in Florida, they are of additional interest as evidences of the existence in this region of a formation of tertiary age not previously known. An accompanying letter from Dr. J. C. Neal, of Archer, Florida, informs us that the fossils

were discovered in a bed of clay, occupying a ridge in the pine forest. They occurred over an irregular area of one hundred feet long by thirty feet wide, and were dug from variable depths of seven feet to the bed-rock, the character of which is not stated. The fossils, consisting of bones and a few teeth, are mostly in fragments, but exhibit no appearance of being water-worn, or abraded by friction among gravel. In the collection, for the present hastily examined, there may be observed the following more conspicuous remains:—

1. Those of a young mastodon, consisting of bone fragments and detached epiphyses. The epiphysial head of a femur measures 6¼ inches in diameter. In the clay adherent to the rough under surface, the vertebra of a teleost fish is imbedded. An astragalus measures 4½ inches fore and aft, and 5½ inches transversely.

2. Remains, apparently of several individuals of a rhinoceros, rather smaller than the Indian rhinoceros. Among them are small fragments of a mandible, and portions of lower molar teeth. The nearly complete crown of one of the latter measures 2¼ inches fore and aft, with 1¼ inches width in front. The limb bones indicate an animal of shorter stature, but equally robust proportions to those of the Indian rhinoceros. There are two nearly entire radii, 9 inches long, by 3½ inches width at the proximal, and 3¼ inches width at the distal end. The distal extremity of a femur measures 6 inches at the epicondyles. The head of a tibia is 5¼ inches wide and 3½ inches fore and aft. A calcaneum is 5 inches long. Three middle metacarpels exhibit the following measurements:—

Length, . . .	4½ inches,	4 inches,	3¾ inches.
Width, proximal end,	2¾ "	2½ "	2¼ "
Width, distal end, .	2½ "	2¼ "	2⅛ "

3. Small fragments of the maxillæ of a tapir; one with an entire molar tooth, which differs neither in form nor size from the corresponding tooth of the living *Tapirus americanus*. The tooth measures 11 lines fore and aft by 13 lines transversely.

4. Remains, apparently of a llama, as large as the camel. The distal end of a metacarpel is about 4 inches in breadth. A first phalanx is 4½ inches long by 2¼ inches wide at the proximal end and 1⅝ inches at the distal end.

5. A calcaneum of a ruminant, not quite so long as that of the Irish elk, but of more robust proportions. Its reference is uncertain, and it is doubtful whether it pertains to the extinct *Cervus americanus*.

6. The vertebral centrum of a small crocodile.

7. Remains of several other animals undetermined.

APRIL 29.

The President, Dr. LEIDY, in the chair.

Twenty-seven persons present.

A paper entitled "New Fossils from the four groups of the Niagara Period of Western New York," by Eugene N. S. Ringueberg, was presented for publication.

On the Digestion of Raw and of Boiled Milk.—DR. N. A. RANDOLPH referred to certain profound changes produced in milk by boiling. In this operation the casein is not coagulated, but there is an evolution of sulphuretted hydrogen (Schreiner), a diminution in the gaseous constituents of the fluid and a change in the amount of ozone present.

The most striking difference between raw and boiled milk lay in their respective responses to rennet, acids and alkalies.

At the body-temperature the firm coagulation of raw milk occurred almost immediately upon the addition of a neutral rennet solution, whereas boiled milk, under the same conditions, did not clot for a far longer period, and the coagula were not firm. On the other hand, dilute or strong acids were tenfold as active upon boiled as upon raw milk. Some time after making these experiments Dr. Randolph found that so far as acids and rennet were concerned, similar results had been obtained by Schreiner (Chem. Centralbl., III. Folge, IX. Jahrg.), and he desired to present his observations in these particulars simply as confirmatory of those of that observer.

Upon the addition of dilute alkalies to boiled milk, the rise of cream was much more rapid and complete than in raw milk under the same conditions.

Artificial digestions showed that milk was more readily digested when raw than when boiled. This was further confirmed by a comparative examination and weighing (in over fifty cases, and in which he was aided by Dr. Roussel) of the contents of the stomach after raw and boiled milk had been, in different individuals, undergoing actual gastric digestion. In these cases the residue found in the stomachs of those persons receiving boiled milk was greater than the similar residue found in the stomachs where raw milk had been undergoing digestion for the same length of time.

The following were elected members: Messrs. J. L. Forwood, L. Woolman, John Eyerman, Edw. Jackson, E. J. Wheelock and Miss S. D. Atkinson.

Ernest André, of Gray, Haute Saône, France, was elected a correspondent.

The following were ordered to be printed:—

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS TRACHYNOTUS.

BY SETH E. MEEK AND DAVID K. GOSS.

In the present paper we give the synonymy of the species of *Trachynotus* found in American waters, with brief descriptions of those known to us found on the Atlantic Coast. The latter are here all described from specimens obtained by Professor Jordan at Havana and Key West. We are very much indebted to Professor Jordan for use of his library and for valuable aid.

In the following analysis of species, *Trachynotus marginatus* is omitted, the original description being too insufficient for comparison. Of the remaining seven species, two (*rhomboides*, *glaucus*) appear to be confined to the Atlantic; two others (*kennedyi*, *fasciatus*) represent those on the Pacific Coast, while the others (*rhodopus*, *carolinus*, *cayennensis*) appear to be found on both sides, although in the case of *rhodopus* and *carolinus* being far more abundant in the Atlantic.

Analysis of Species of Trachynotus.

a. Dorsal with 19 to 20 soft rays; anal with 17 to 19 soft rays.

b. Body very much compressed; sides with narrow black cross-bars; lobes of vertical fins elongate, reaching past middle of caudal fin in adult.

c. Snout subtruncate or nearly vertical; profile from supraorbital to front of dorsal fin convex. *glaucus.* 1.

cc. Snout low, very oblique; profile from supraorbital region to the dorsal scarcely convex. *fasciatus.* 2.

bb. Body moderately compressed; sides without narrow black cross-bars; lobes of vertical fins shorter, rarely reaching base of caudal; lobes of dorsal and anal usually blackish.

d. Body broad, ovate; the greatest depth at all ages more than half length of body; lobes of the vertical fins reaching in the adult beyond the middle of their fins.

e. Axil with a large black spot (in the adult); profile strongly convex anteriorly. *kennedyi.* 3.

ee. Axil without dark spot; profile from nostril to dorsal everywhere about equally convex.

 rhomboides. 4.

dd. Body oblong; the depth in young and old about $\frac{2}{5}$ length of body. *rhodopus.* 5.

aa. Dorsal with 25 to 27 soft rays; anal with 22 to 26 soft rays; body oblong, rather robust; greatest thickness 3 in greatest depth of body; depth less than half length; lobes of vertical fins short, not black; sides without dark cross-bars.

f. Dorsal with 25 soft rays; anal with 22 soft rays; profile from snout to procumbent spine evenly convex. *carolinus.* 6.

ff. Dorsal with 27; anal with 26 soft rays. *cayennensis.* 7.

Trachynotus glaucus. *Gaff-top-sail Pompano. Old wife.*

Chætodon glaucus Bloch, Ichthyologia, Pl. ccx, about 1783 (on a figure by Plumier).

Acanthinion glaucus Lacépède, iv, 1803, 500 (copied).

Trachinotus glaucus Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 400 (Brazil, Havana, Mexico, San Domingo, Martinique and Guadeloupe); Guichenot, "Poiss. Ramon de la Sagra, Hist. Cuba, 107, 1845" .(Cuba).

Trachynotus glaucus Günther, Cat. Fishes Brit. Mus., ii, 1860, 483 (Antilles, Jamaica and Rio Janeiro); Gill, Proc. Acad. Nat. Sci. Phila., 1862, 438 (Charleston, S. C.); Gill, Rep. U. S. Fish Com., 1871–2, 803 (name only); Goode, Proc. U. S. Nat. Mus., 1879, 112 (name only); Goode, Bull. U. S. Fish Com., 1881, 37, 40 (Bermudas); Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237 (name only); Jordan & Gilbert, Proc. U. S Nat. Mus., 1882, 270 (Pensacola); Jordan & Gilbert, Syn. Fish. N. A., 1882, 443; Jordan & Gilbert, *op. cit.*, 912.

Habitat.—Atlantic Coasts of America: Charleston, Pensacola, Key West, Bermudas, Jamaica, Antilles, Guadaloupe, Martinique and Rio Janeiro. Also erroneously ascribed (by confusion with *Trachynotus fasciatus*) to Lower California and Panama.

Head 4 in length of body; depth 2; D. VI–I, 19; A. II–I, 18; length (No. 440, I. U. Key West) 13 inches.

Body elliptical, much compressed; snout blunt, subtruncate, vertical from mouth to horizontal from upper edge of eye; the profile from supraorbital to front of dorsal fin convex; eye $3\frac{3}{5}$ in head; mouth nearly horizontal; maxillary nearly reaches vertical from middle of eye, its length 3 in head; jaws without teeth in the adult; dorsal spines separate, in the adult; dorsal and anal fins falcate, the anterior soft rays reaching middle of

caudal fin; dorsal lobe $1\frac{1}{2}$, anal $1\frac{2}{3}$ in length of body; ventrals reaching $\frac{3}{4}$ distance to vent, their length $2\frac{2}{3}$ in head; caudal very deeply forked, their lobes nearly half length of body. Color bluish above, golden below; lobes of dorsal and anal very dark, rest of the fins pale, with bluish edges; caudal bluish; Pectorals golden and bluish; ventrals whitish. Body crossed by four black vertical bands; the first is under the procumbent spine, the second under the third dorsal spine, the third and fourth under the soft dorsal. A black spot, representing a fifth band, on latter line between the last rays of dorsal anal; this is sometimes obsolete; the position of these bands appears to be subject to slight variation. The young of this species has not yet been described.

Trachynotus fasciatus.

Trachynotus fasciatus Gill, Proc. Acad. Nat. Sci. Phila., 1863, 86 (Cape San Lucas); Günther, Fishes Cent. America, 1869, 434 (Panama, San Jose and Nicaragua); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Porto Escondido, Mexico); Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 106 (Mazatlan, no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 359 (Cape San Lucas, no description).

Trachynotus glaucoides Günther, Proc. Zool. Soc., 1864, 150 (San Jose; Nicaragua).

Habitat.—Pacific Coast of Tropical America: Cape San Lucas, Mazatlan, Porto Escondido, San Jose, Nicaragua, and Panama.

This species is the Pacific representative of *Trachynotus glaucus*, which species it strongly resembles. The difference in the profile is, however, constant and characteristic.

Trachynotus kennedyi.

Trachynotus kennedyi Steindachner, Ichthyol., Beiträge, iii, 1875, 47, Pl. vii, (Magdalena Bay); Günther, Fish. Cent. Amer., 1869, 388 (in part, Panama).

Trachynotus ovatus Lockington, Proc. Cal. Acad. Nat. Sci., 1876, 4 (Lower California); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 375 (Panama, not of Cuv. & Val.).

Trachynotus rhomboides Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 625 (Panama, young).

Trachynotus rhodopus Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 106 (Mazatlan, not of Gill).

Habitat.—Pacific Coast of Tropical America: Magdalena Bay, Mazatlan, Panama.

This species is the Pacific Coast representative of *Trachynotus rhomboides*, from which it differs in the presence of a black axil-

lary spot, and slightly in form of the profile. The young lack this spot, and cannot readily be distinguished from the young of *Trachynotus rhomboides*. It is therefore probable that all the references made by authors to the occurrence of *T. rhomboides* (*ovatus*) on the Pacific Coast of Tropical America refer to this species. A series brought by Professor Gilbert from Panama (now unfortunately destroyed) is said to render this view very probable. We are informed by Professor Jordan that the specimens brought by Professor Gilbert from Mazatlan, recorded as *T. rhodopus*, belong to this species, of which the latter cannot be the young, as was at first supposed.

Trachynotus rhomboides. *Round Pompano; Palometa.*

Chætodon rhomboides Bloch, Ichthyologia, ccix, about 1783 (on a drawing by Plumier); Gmelin, Syst. Nat., 1788, 1259 (copied).

Acanthinion rhomboides Lacépède, Hist. Nat. Poiss., iv, 1803, 500 (copied).

Trachinotus rhomboides Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 407 (Martinique); Guichenot "Poiss. Ramon de la Sagra, Hist. Cuba, 1845, 108" (Cuba).

Trachynotus rhomboides Lütken, Spolia Atlantica, 1880, 602 (West Indies); Jordan & Gilbert, Syn. Fish. N. A., 1882, 974.

Spinous dory Mitchill, Trans. Lit. and Phil. Soc., 1815, Pl. vi, f. 10 (no description).

Trachinotus fuscus Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 410 (Brazil).

Trachinotus spinosus De Kay, N. Y. Fauna Fishes, 1842, 117, Pl. xix, fig. 53 (New York Harbor); Storer, "Syn. Fish. N. A., 1846, 98."

Lichia spinosus Baird, Ninth Smithsonian Rep., 1854, 22 (Beesley's Point, New Jersey).

Doliodon spinosus Girard, U. S. and Mex. Bd. Surv., 1859, 22 (St. Joseph's Island, Texas); Gill, Cat. Fish. East Coast N. A., 1861, 37 (name only).

Trachynotus ovatus Günther, Cat. Fish. Brit. Mus., ii, 1860, 481 (in part, West Indian specimens, apparently not *Gasterosteus ovatus*, which is the Asiatic species); Gill, Proc. Acad. Nat. Sci. Phila., 1862, 438; Gill, Proc. Acad. Nat. Sci. Phila., 1863, 332; Gill, Rep. U. S. Fish Com., 1871-2, 803; Baird, Rep. U. S. Fish Com., 1871-2, 825 (Wood's Holl, Mass.); Goode, Proc. U. S. Nat. Mus., 1879, 112 (name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 376 (Beaufort, N. C., no description); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 339 (Marquesas Keys, Fla.); Goode, Bull. U. S. Fish Com., 1880, 24 (name only); Goode, Bull. U. S. Fish Com., 1881, 36-39; Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237 (name only); Jordan & Gilbert, Syn. Fish. N. A., 1882, 442.

Habitat.—Atlantic Coast of America: Wood's Holl, New York,

Beesley's Point, Beaufort, Marquesas Keys, Key West, St. Joseph's Island, Martinique, and Brazil.

Head $3\frac{3}{4}$ in length; depth $1\frac{3}{5}$; D. VI–I, 19; A. II–I, 18; length (No. 486, I. U. Havana) 18 inches.

Body broadly ovate, moderately compressed; profile very evenly convex from procumbent spine to horizontal from upper edge of eye, where it descends almost vertical. The vertical portion is about $1\frac{1}{3}$ times the eye; length of snout nearly equals the eye; mouth nearly horizontal; maxillary reaching to the vertical from middle of eye, its length $2\frac{2}{3}$ in head; jaws without teeth in adult; dorsal spines short and thick, not connected by membrane in adult; ventrals short, their tips scarcely reaching half way to anterior anal spine; 3 in head; caudal widely forked; lobes about $2\frac{2}{3}$ in length of body; dorsal and anal fins falcate; anterior rays reaching almost to posterior end of fins; in adults, dorsal lobe $2\frac{2}{3}$, anal lobe $4\frac{1}{2}$, in length of body. Color bluish above, silvery below; lobes of dorsal black in young; in adults the fins are all bluish with lighter tips.

The young differ from the adult as above described in the following respects: The profile is scarcely convex; snout shorter and less vertical; spines much longer and connected by membranes; lobes of vertical fins shorter; dorsal lobe with black; fins all much paler; jaws with bands of villiform teeth; eye larger; color much paler.

We have had no opportunity of comparing the American *Trachynotus rhomboides* with the East Indian *Trachynotus ovatus* with which it has been identified by Dr. Günther. We have been led to consider them as distinct by the following observation of Dr. Lütken: "I will only remark that the *Trachynotus rhomboides* of the Antilles has already its rhomboidal physiognomy and the falcations of its fins strongly prolonged at an age at which, in the *Trachynotus ovatus* of the seas of the Indies, these prolongations of the fins are quite short. I am of the opinion (with Mr. Gill) that these two species ought, at least provisionally, to be considered as distinct."

As the antecedent probabilities are against the identity of these species in such widely separated faunæ, there is less danger of confusion in regarding the two as different.

Trachynotus rhodopus. *Permit. Great Pompano.*

Trachynotus goreensis Günther. Cat. Fish. Brit. Mus., 1860, 483 (specimens from Caribbean Sea; in part, not of Cuvier & Valenci-

ennes); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 129 (West Florida, Jupiter's Inlet); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 339 (West Florida, Marquesas Keys); Goode, Proc. U. S. Nat. Mus., 1879, 112 (name only); Goode, Bull. U. S. Fish Com., 1881, 36, 40 (Key West and Jupiter's Inlet); Goode, Bull. U. S. Nat. Mus., 1880, 24 (name only); Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237 (name only); Jordan & Gilbert, Syn. Fish. N. A., 1882, 442; Jordan & Gilbert, *op. cit.*, 1882, 974.

Trachynotus rhodopus Gill, Proc. Acad. Nat. Sci. Phila., 1863, 85 (Cape San Lucas; young).

Trachynotus nasutus Gill, Proc. Acad. Nat. Sci., 1863, 85 (Cape San Lucas; very young).

Trachynotus carolinus, Poey, Syn. Pisc. Cubensium, 1868, 371 (Cuba); Poey, Enumeratio Pisc. Cubensium, 1875, 86.

Habitat.—Both coasts of Tropical America: West Florida, Jupiter's Inlet, Marquesas Keys, Key West, Cuba, Caribbean Sea, Cape San Lucas.

Head 3 in length; depth $2\frac{3}{8}$; D. VI–I, 19; A. II–I, 17; length of specimen described (Key West), $2\frac{1}{3}$ inches.

Body oblong, elliptical, moderately compressed; profile nearly straight from procumbent spine to nostril, where it descends nearly vertical, forming an angle; vertical portion from angle to snout nearly equals the eye; maxillary reaches slightly behind vertical from middle of eye, its length $2\frac{2}{3}$ in head; jaws with bands of villiform teeth (these disappearing with age); ventrals reaching $\frac{3}{5}$ distance to vent, their length 2 in head; tips of pectorals reaching slightly past tips of ventrals; dorsal spines connected by a membrane, which is only characteristic of the young. Dorsal and anal fins falcate, their anterior soft rays less elevated than in *Trachynotus rhomboides*, but extending beyond middle of fins when depressed. Length in the young 4 in length of body; caudal forked, lobes about 3 in body; lateral line nearly straight, slightly curved upwards above the pectorals; color bluish silvery above, silvery below; dorsal, caudal and anal lobes blackish; no crossbars.

This species grows to a much larger size than any other of the genus found in our waters; specimens of 2 to 3 feet in length being not uncommon in Florida and Cuba. It has been identified with the *Trachynotus goreënsis* of Cuvier & Valenciennes, by most American authors, this being a species from the West Coast of Africa. The basis of this identification appears to be insufficient. According to Cuvier & Valenciennes this *Trachynotus*

goreënsis is a deeper fish than ours is at any age. Its outline and coloration are also different.

Trachynotus maxillosus Cuvier & Valenciennes, also from Africa, comes much nearer our fish, but this differs too much to be safely identified with it.

On the other hand, our young specimens correspond exactly to the two descriptions of little Trachynoti taken by Xantus at Cape San Lucas, published by Professor Gill; the larger one ($2\frac{1}{3}$ inches in length) corresponds entirely to the *T. rhodopus*, the smaller one ($1\frac{1}{10}$ inches in length) to *T. nasutus*. There is, however, no other record of the occurrence of our species in the Pacific.

The drawings and notes made by Professor Poey, of the species called by him *T. carolinus*, have been examined by Professor Jordan. They belong to *T. rhodopus*. *T. carolinus* is therefore as yet not known from Cuba.

Trachynotus carolinus.

Gasterosteus carolinus Linnæus, Syst. Nat., ed. 12, 1766, 490 (Carolina).

Doliodon carolinus Girard, Proc. Acad. Nat. Sci. Phila., 1858, 168; Girard, U. S. & Mex. Bd. Surv., 1839, 22, Pl. xi, fig. 4 (St. Joseph's Island, Texas); Gill, Cat. Fish. East Coast N. A., 1861, 37 (name only).

Trachynotus carolinus Gill, Proc. Acad. Nat. Sci. Phila., 1862, 438; Gill, *op. cit.*, 1863, 84 (Cape San Lucas); Gill, Proc. Acad. Nat. Sci. Phila., 1863, 332 (name only); Gill, Rep. U. S. Fish Com., 1871–2, 803 (name only); Baird, Rep. U. S. Fish Com., 1871–2, 825 (Wood's Holl); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort, N. C., no description); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 129 (Pensacola, Fla.); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 112 (name only); Bean, Proc. U. S. Nat. Mus., 1880, 90 (Wood's Holl, New York and Newport, R. I.); Goode, Bull. U. S. Fish Com., 1881, 36; Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 596 (Charleston, S. C., no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 359 (Cape San Lucas); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 270 (Pensacola, Fla., no description); Goode, Bull. 21, U. S. Nat. Mus., 1880, 24 (name only); Jordan & Gilbert, Syn. Fish. N. A., 1882, 442; Jordan, Proc. Acad. Nat. Sci. Phila., 1884, 45 (Egmont Key).

Trachinotus cupreus Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 414 (Martinique).

Trachinotus argenteus Cuvier & Valenciennes, Hist. Nat. Poiss., 1831, 413 (Martinique); Storer, Syn. Fishes N. A., 1846, 98.

Trachynotus argenteus Gill, Cat. Fish. East Coast N. A., 1861, 37 (name only).

Trachynotus pampanus Cuv. & Val., *op. cit.* (Charleston, S. C.); Storer, Syn. Fish. N. A., 1846, 99.

Trachynotus pampanus Günther, Cat. Fish. Brit. Mus., ii, 1860, 484 (Jamaica); Gill, Proc. Acad. Nat. Sci. Phila., 1862, 262 (Cape San Lucas).

Bothrolæmus pampanus Holbrook, Ich. S. Cav., 1860 (Charleston); Gill, Cat. Fish. East Coast N. A., 1861, 37 (name only).

Lichia carolina De Kay, N. Y. Fauna, iv, 1842, 114, Pl. x, f. 3 (Sandy Hook); Storer, Syn. Fish. N. A., 1846, 96; Baird, Ninth Rep. Smith. Inst., 1854, 21 (Beesley's Point, N. J.).

Habitat.—Atlantic (and Pacific) Coasts of America: Wood's Holl, Newport, Sandy Hook, Beesley's Point, Beaufort, Charleston, Pensacola, St. Joseph's Island, Egmont Key, Key West, Martinique and Cape San Lucas.

Head 4 in length; depth $2\frac{2}{5}$; D. VI–I, 25; A. II–I, 22. Length (No. 434, I. U., Key West) $15\frac{1}{2}$ inches.

Body oblong, comparatively robust; greatest thickness 3 in greatest depth. Snout from mouth to horizontal from upper edge of eye nearly vertical, somewhat bluntly rounded; profile from upper edge of snout to procumbent spine evenly convex. Mouth nearly horizontal, maxillary reaching to vertical from middle of eye, its length $2\frac{2}{3}$ in head; eye $4\frac{1}{2}$ in head, about as long as snout. Jaws without teeth in adult. Ventrals reach $\frac{3}{5}$ distance to vent, about 2 in pectorals, $2\frac{1}{2}$ in head. Dorsal and anal fins falcate; anterior rays nearly reach middle of fins when depressed; dorsal lobe $4\frac{1}{2}$; anal $5\frac{1}{2}$ in length of body. Color bluish above, silvery or slightly golden below; pectorals and anal light orange shaded with bluish; caudal and upper portion of caudal peduncle with bluish reflections.

On our South Atlantic and Gulf Coasts this is by far the most abundant species of the genus, and it is the one most esteemed as food. Its distribution in the West Indies is little known, the only positive record from points south of Key West being that of "*Trachynotus cupreus*" from Martinique. The only specimens known from the West Coast are those taken by Xantus at Cape San Lucas. While we have no good reason to doubt that the specimens now in the National Museum really came from Xantus, it is strange that no later collectors in Lower California and Sinaloa have found either this species or *Trachynotus rhodopus.*

Trachynotus cayennensis.

Trachinotus cayennensis Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 417 (Cayenne); Günther, Cat. Fish. Brit. Mus., ii, 1860, 485 (copied).

? *Trachinotus paitensis* Cuv. & Val., *op. cit.*, viii, 1831, 438 (Peru).

Nothing is known of this species except what is contained in the two meagre descriptions noticed above. No difference is indicated by which the Pacific Coast fish (*paitensis*) is to be known from the Atlantic one. Both appear to differ from *T. carolinus* in the still longer vertical fins.

Trachynotus marginatus.

Trachinotus marginatus Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 411 (Montevideo).

This species appears to be allied to *Trachynotus rhodopus* and *T. goreënsis*, but the description is too brief to give much idea of its relations.

Recapitulation.

We have in this paper admitted eight species of *Trachynotus*, as found in American waters. Some doubt is attached to the nomenclature of some of them. We give in the following list a brief indication of the questions remaining to be solved in each case:—

Genus **TRACHYNOTUS** Lacépède.

1. **T. glaucus** Bloch.
2. **T. fasciatus** Gill.
3. **T. kennedyi** Steindachner (possibly to be considered as a geographical variety of *T. rhomboides* or of *T. ovatus*).
4. **T. rhomboides** Bloch (possibly identical with the East Indian *T. ovatus* Linnæus; if so, to take the latter name).
5. **T rhodopus** Gill. Very improbably identical with *T. goreensis* Cuv. & Val.; possibly identical with *T. maxillosus* Cuv. & Val., both of them being African species of prior date. Possibly not really found in the Pacific).
6. **T. carolinus** Linnæus (possibly not occurring in the West Indies or in the Pacific).
7. **T. cayennensis** Cuv. & Val. (imperfectly described; possibly the Pacific form of *T. paitensis* is distinct).
8. **T. marginatus** Cuv. & Val. (imperfectly described and doubtful).

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS SYNODUS.

BY SETH E. MEEK.

I have attempted in this paper to give a review of the American species of *Synodus*, with a detailed description of certain species imperfectly described elsewhere. The paper is based on specimens collected by Professor Jordan at Cedar Keys and Key West, Florida, and Havana, Cuba, belonging to the United States National Museum and the Museum of the Indiana University. All the Atlantic species here recognized, except *Synodus saurus*, are contained in this collection.

I am very much indebted to Professor Jordan for use of his library and for other aids.

Analysis of American Species of Synodus.

a. Snout short, obtuse, $3\frac{1}{2}$ in length of premaxillary; head somewhat compressed, much deeper than broad; anal fin comparatively long, its rays about 14; head $3\frac{2}{3}$ in length; origin of dorsal midway between snout and adipose fin; scales 4–55–6 (*Trachinocephalus* Gill). *myops.* 1.

aa. Snout long, pointed, about $2\frac{1}{2}$ in premaxillary; head depressed, little if any deeper than broad; anal comparatively short, rays 10 to 12; head 4 to $4\frac{2}{3}$ in length (*Synodus*).

b. Scales large, 43 to 50 in lateral line; origin of dorsal midway between tip of snout and adipose fin; lateral line with a blunt keel posteriorly.

c. First and last rays of dorsal coterminous when the fin is depressed; black blotch of scapula very small or obsolete; D. I–10; A. I–11 to 12; scales 4–45–5. *intermedius.* 2.

cc. Tips of first dorsal rays not reaching last when the fin is depressed; scapula with a large black blotch; D. I–11 to 12; A. I–10 to 11; scales 4–48–6. *anolis.* 3.

bb. Scales small, 55 to 70 in lateral line.

d. Dorsal fin much higher than long; tips of first rays extending beyond tips of last when the fin is depressed; length of fin $1\frac{5}{6}$ in length of longest ray, and $2\frac{1}{2}$ in head; teeth large; D. I–9; A. I–11; scales 4–57–6. *spixianus.* 4.

dd. Dorsal fin slightly higher than long; tips of first rays not extending beyond tips of last when the fin is depressed; teeth small.

e. Snout broader than long, the jaws subequal; tail with a slight keel; scales $3\frac{1}{2}$–60–6. *saurus*. 5.

ee. Snout longer than broad, the lower jaw included; tail without keel.

f. Four rows of scales between lateral line and adipose fin (6 in an oblique row); origin of dorsal fin nearer adipose fin than tip of snout; scales on cheeks in about 4 to 7 rows, on opercles in 4 to 5 rows.

g. Head very small, $4\frac{3}{5}$ in length; first rays of dorsal coterminous with last ray when the fin is depressed; cheeks with about 4 rows of large scales, opercles with about 4; ventrals $1\frac{1}{7}$ in head; pectoral 2 in head; D. I–10; A. I–12; scales 6–61–6. *sciticeps*. 6.

gg. Head 4 in length; tips of first rays of dorsal not reaching tips of last when the fin is depressed; scales on cheeks in about 7 rows, on opercles in about 5 rows; ventrals $2\frac{1}{3}$ in head; D. I–10 to 11; A. I–10 to 11; scales 4–64–6. *fœtens*. 7.

ff. Six rows of scales between adipose fin and lateral line; cheeks with about 9 rows of scales, opercles with about 8 rows; D. I–10; A. I–11; scales 13–66–16. *lucioceps*. 8.

Synodus myops.

Salmo myops Bloch & Schneider, Systema Ichthyol., 1801, 421 (St. Helena).

Saurus myops Cuvier & Valenciennes, Hist. Nat. Poiss., xxii, 1849, 485 (South Carolina, Martinique, Bahia, St. Helena); Günther, Cat. Fish. Brit. Mus., v, 1864, 398 (Cuba, Jamaica); Jordan & Gilbert, Syn. Fish. N. A., 1882, 281.

Trachinocephalus myops Poey, Syn. Pisc. Cub., 1868, 415 (Cuba).

Salmo fœtens Bloch., Ichthyologia, about 1790, taf. 384, fig. 2; Bloch & Schneider, Systema Ichthyol., 1801, 404 (not Linnæus).

Osmerus lemniscatus Lacépède, Hist. Nat. Poiss., v, 1803, 236 (on a drawing by Plumier).

Saurus truncatus Agassiz, Spix, Pisc. Bras., 1829, 82, tab. 45 (Brazil).

Saurus brevirostris Poey, Memorias Cuba, ii, 1860, 305 (Cuba).

Trachinocephalus brevirostris Poey, Syn. Pisc. Cub., 1868, 415 (Cuba); "anal rays 10;" Poey, Enum., 1875, 144.

Habitat.—Tropical Atlantic; Cuba; Jamaica; Martinique; Bahia; St. Helena; Brazil and South Carolina.

Head $3\frac{3}{4}$ in length of body; depth $5\frac{1}{2}$; D. I–10; A. I–14; scales 4–55–6 (transverse series counted vertically from dorsal fin to vent respectively).

Body little compressed; snout short, obtuse, $3\frac{1}{2}$ in premaxillary; mouth large, premaxillary $1\frac{2}{3}$ in head; interorbital area concave, about $6\frac{1}{2}$ in head, upper surface of head rugose. Dorsal slightly higher than long, its length $1\frac{1}{2}$ in head; origin of dorsal fin midway between tip of snout and adipose fin, slightly behind last rays of ventrals. Anal fin long, its base nearly equal to head; pectorals reaching root of ventrals, 2 in head; tips of ventrals almost reaching vent, ventrals $4\frac{1}{3}$ in length of body; caudal forked; teeth comparatively small; lower jaw slightly projecting. Color grayish, mottled with darker above; body with eleven cross-bars; a black blotch on scapula; a black streak extending from eyes around symphysis, forming a quadrated blotch on the side of each jaw, and one on the median line of each jaw; dorsal fin faintly barred; pectorals, ventrals and anal plain.

This description is taken from a very young specimen, twenty-three inches in length, collected by Professor Jordan in Havana. In the above synonymy we have omitted references from the Pacific Ocean, thinking it not impossible that the Asiatic species (*limbatus*) is a species distinct from *S. myops*. *Trachinocephalus brevirostris* Poey, known only from a drawing made in 1857, seems to differ only in the presence of ten instead of fifteen anal rays. This is probably an error, or perhaps an accidental mutilation. I have little doubt that it is a synonym of *S. myops*.

Synodus intermedius.

? ? ? *Synodus* Gronov., Mus. Ichth., ii, 1765, No. 151, tab. 7, fig. 1.

? ? ? *Esox synodus* Linnæus, Syst. Nat., i, 1766, 516 (America).

? ? ? *Synodus synodus* Bloch & Schneider, Systema Ichthyol., 1801, 396.

? *Saurus synodus* Cuv. & Val., Hist. Nat. Poiss., xxii, 1849 (Martinique; Guadeloupe; Bahia; St. Helena).

? ? ? *Synodus fasciatus* Lacépède, v, 1804, 321.

Saurus intermedius Agassiz, "Spix, Pisc. Brazil, 1829, 81, tab. 44 (Brazil)."

Synodus intermedius Poey, Enum. Pisc. Cub., 1875, 143 (Cuba, not of Synopsis).

Habitat.—Cuba; Brazil.

Head 4 in length of body; depth $6\frac{3}{4}$; D. I–10; A. I-10; scales 4–44–4 (transverse series counted from dorsal and vent respectively).

Body terete, rather robust; snout comparatively long and pointed, about $3\frac{3}{4}$ in head; mouth large; premaxillary about $1\frac{3}{4}$ in head; interorbital area concave, about $6\frac{1}{2}$ in head; supraorbital ridge present, terminating anteriorly before the nostrils.

Origin of dorsal fin midway between tip of snout and adipose fin; anterior rays of dorsal coterminous with posterior ones when the fin is deflexed; fin higher than long, its length about 2 in head, lower jaw slightly projecting; teeth moderate, anterior palatine teeth largest, becoming smaller posteriorly.

Lateral line with a blunt keel posteriorly, tips of ventrals reaching $\frac{3}{5}$ distance to vent, their length about $1\frac{1}{4}$ in head; tips of pectorals extending to roots of ventrals, $1\frac{4}{5}$ in head; caudal forked, lobes equal, scales large. Color yellowish above, lighter below, scales above lateral line punctulate with dark; breast flesh-colored; sides with a row of irregular black markings; scapula occasionally with a small black spot, faintly barred with black; caudal not barred, dusky; tips of middle rays darkest; other fins plain.

This description is taken from several specimens, the largest 5 inches in length, collected by Professor Jordan at Havana.

This is evidently the *Synodus intermedius* of Poey's Enumeratio. I have been unable to examine the figure of Agassiz and Spix, but from the account given of it by Poey, we infer that it is taken from specimens of the present species rather than of *S. cubanus*. According to Poey, the species figured by Spix lacks the scapular spot.

Synodus anolis.

[1] *Saurus anolis* Cuvier & Valenciennes, Hist. Nat. Poiss., xxii. 1849, 438 (Bahia; Martinique).

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[1] Since the above was in type the following notes have been received by Prof. Jordan from Dr. H. E. Sauvage, of the Museum of Paris: "*Saurus anolis* C. & V. Bahia. Type. Length of body 245 m. Lateral line with 54 scales: 10 in a transverse series. A well-marked black spot on the scapular part of the gill-openings." There seems to be no doubt of the identity of *anolis* and *cubanus*.

Saurus intermedius Günther, Cat. Fish. Brit. Mus., v, 1864, 396 (Jamaica; Demarara; Bahia; not of Agassiz).

Synodus intermedius Poey, Syn. Pisc. Cub., 1868, 414 (Cuba); Jordan & Gilbert, Syn. Fish. N. A., 1882, 889; Goode & Bean, Proc. U. S. Nat. Mus., 1882, 239 (name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 249 (Pensacola, Fla.).

Synodus cubanus Poey, Enum. Pisc. Cub., 1875, 143 (Cuba).

Habitat.—Atlantic shores of Tropical America; Pensacola; Key West; Cuba; Jamaica; Martinique; Demarara and Bahia.

The description of *Saurus anolis* is so insufficient, that no certain identification can be made.

This species has been sufficiently described by Jordan & Gilbert (Proc. U. S. Nat. Mus., 1882, 249). The large specimens from Key West, examined by me, agree well with this account.

Synodus spixianus.

Saurus spixianus Poey, Memorias Cuba, ii, 1860, 304 (Cuba).

Synodus spixianus Poey, Syn. Pisc. Cuba, 1868, 413 (Cuba); Poey, Enum. Pisc. Cub., 1875, 397 (Cuba).

Habitat.—Cuba; Key West.

Head $4\frac{1}{6}$ in length of body; D. I–9; A. I–11; scales 4–57–6 (transverse series counted from dorsal and vent respectively).

Body oblong, nearly terete; snout comparatively long and pointed, $3\frac{1}{2}$ in head and about $2\frac{1}{2}$ in premaxillary. Interorbital area concave, 6 in head. Eye 5 in head. Supraorbital striate. Branchiostegals 16. Origin of dorsal fin nearer adipose fin than tip of snout by length of dorsal fin; tips of anterior rays reaching beyond tips of posterior ones when the fin is deflexed; the fin is therefore much higher than long. Length of fin $1\frac{3}{8}$ in length of longest ray and $2\frac{1}{2}$ in head. Ventrals moderate, reaching about $\frac{3}{8}$ distance to vent, $1\frac{1}{3}$ in head. Tips of pectorals not réaching to roots of ventrals, about 2 in head. Adipose fin situated over middle of anal. Caudal forked, its lobes equal. Teeth larger than in the other species. Palatine teeth becoming smaller posteriorly. Color light sandy gray, much mottled above with darker olive. Branchiostegals very pale, yellowish. Ventrals and anal pale and plain, lower lobe of caudal dusky, neither barred. Dorsal faintly barred with darker olive.

This description taken from one specimen $8\frac{1}{2}$ inches long, collected by Professor Jordan in Havana. Numerous smaller ones from Key West have also been examined.

Synodus saurus.

Osmerus radiis pinnæ ani undecim Artedi, Descript. Spec. Pisc., 1738, 22 (Mediterranean).

Salmo saurus Linnæus, Syst. Nat., i, ed. 12, 1766, 511 (Europe).

Saurus lacerta Cuvier & Valenciennes, Hist. Nat. Poiss., xxii, 1849, 463 (Europe, not of Risso).

Synodus lacerta Goode, Bull. U. S. Nat. Mus., 1876, 68 (Bermudas).

Saurus griseus Lowe, Trans. Zool. Soc., ii, 1841, 188 (Madeira); Günther, Cat. Fish. Brit. Mus., v, 1864, 394 (Madeira, St. Vincent, Naples, Mediterranean).

I have not seen this species. Professor Goode (Bull. U. S. Nat. Mus., 1876, 68) makes the following reference to its occurrence in the Bermudas:—

"A specimen seventeen inches long was taken off the 'ducking-stool' in March, by a line fisherman. Its occurrence in this part of the Atlantic is very novel, but it agrees closely with a specimen of *Saurus griseus* sent to the United States National Museum by Dr. Günther. Its color was dusky gray above, yellow below. Its formulæ are as follows: Branchiostegals, 16–17 (on opposite sides); D. 12; A. 12; lateral line, 60; transverse line, $\frac{3\frac{1}{2}}{6}$."

Synodus scituliceps.

Synodus scituliceps Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 344 (Mazatlan); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 354 (Cape San Lucas); Jordan & Gilbert, Bull. U. S. Fish. Com., 1882, 106 (Mazatlan); Jordan & Gilbert, Bull. U. S. Fish. Com., 1882, 109 (Panama).

Saurus fœtens Günther, Cat. Fish. Brit. Mus., 1864, 396 (in part; specimen from Panama).

Habitat.—Mazatlan, Panama.

Synodus fœtens.

Salmo fœtens Linnæus, Syst. Nat., i, ed. 12, 1766, 513 (Carolina).

Saurus fœtens Cuvier & Valenciennes, Hist. Nat. Poiss., xxii, 1849, 471 (Martinique, St. Domingo, Charleston, S. C.; Bahia, Rio Janeiro); Holbrook, Ichth. S. C., 1860, 187.

Synodus fœtens Gill, Rept. U. S. Fish. Com., 1871–2, 810 (name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 384 (Beaufort, N. C., no description); Goode, Proc. U. S. Nat. Mus., 1879, 119 (name only); Goode & Bean, Proc. U. S. Nat. Mus, 1879, 342 (Key West); Bean, Proc. U. S. Nat. Mus., 1880, 105 (Beaufort, N. C.; no description); Goode & Bean, Proc. U. S. Nat. Mus., 1882, 239 (Gulf of Mexico); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 585 (Charleston, S. C.); Jordan & Gilbert, Syn. Fish. N. A., 1882, 280.

? *Coregonus ruber* Lacépède, v, 1804, 263 (on a drawing by Plumier).
? *Saurus longirostris* Agassiz, "Spix, Pisc. Bras., tab. 43, 1829" (Brazil).

Habitat.—Atlantic shores of America: Beaufort, Charleston, Cedar Keys, Key West, Martinique, St. Domingo, Rio Janeiro.

This is the most common species of the genus on the United States Coast. It is well described by Jordan & Gilbert, Syn. Fish N. A., 1882, 280.

Synodus lucioceps

Saurus lucioceps Ayres, Proc. Cal. Acad. Nat. Sci., 1855, 66 (San Francisco); Günther, Cat. Fish. Brit. Mus., v, 1864, 397 (copied).
Synodus lucioceps Jordan & Gilbert., Proc. U. S. Nat. Mus., 1880, 457 (San Francisco, Monterey Bay, Santa Barbara); Jordan & Jouy, Proc. U. S. Nat. Mus., 1881, 13 (San Francisco, Monterey, Santa Barbara); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 42; Jordan & Gilbert, Syn. Fishes N. A., 1882, 281.
Saurus fœtens Lockington, Ann. Mag. Nat. Hist., about 1878 (erroneously identified with the Atlantic species).

Habitat.—West Coast of U. S.: San Francisco, Monterey, Santa Barbara.

This species resembles *Synodus fœtens*, but has much smaller scales. This is shown especially when the number in vertical series is counted. The only accurate description is that of Jordan & Gilbert, Syn. Fish. N. A., 1882, 281.

May 6.

The President, Dr. Leidy, in the chair.

Sixteen persons present.

A Rare Human Tapeworm.—Dr. Leidy directed attention to some little tapeworms, which had recently been submitted to his examination by Prof. William Pepper. They were expelled, by the use of santonin, from a child of three years. The specimens, consisting of a dozen fragments, appear to be portions of three worms, which reached a length of from twelve to fifteen inches, or more. Unfortunately the head is lost. The joints or proglottides are more than several times the breadth of the length. In a specimen of thirteen inches, comprising nearly a complete worm, the joints of the anterior attenuated extremity are about the one-fifth of a millimetre long by nearly two-thirds of a millimetre wide, while the posterior joints are half a millimetre long and two and a quarter millimetres wide. Ripe joints at the posterior part of the body are pale brown, the color being due to the eggs. These occupy a simple uterus defined by the walls of the joints, and not divided into pouches diverging laterally from a main stem as is usual in most tæniæ. A singular feature of the worm is the interruption of the series of ripe joints, here and there, by one or more completely sterile ones. The generative apertures open in the usual way on the lateral margin of one side. The mature eggs are spherical, measure 0·072 mm. diameter, and contain, fully developed, six hooked embryos.

While differing greatly from the ordinary tapeworms infesting man, they approximate nearly the description of *Tæniæ flavopunctata*, and probably pertain to this species. This has been but once previously observed, and was described in 1858 by Dr. Weinland (An Essay on Tapeworms of Man), from specimens in the Museum of the Medical Improvement Society of Boston. These were also discharged by a child. The worm was estimated to be from eight to twelve inches. The joints were marked by a yellow spot, from which the species was named. The eggs measure from 0·054 to 0·06 mm.

Our specimens indicate a worm almost the same size as the *T. flavopunctata*, but the joints are shorter and wider, and exhibit no yellow spot, and the eggs are larger. In other characters the worms sufficiently accord to render it probable that they may pertain to the same species. It is probable that the worm is more common than would be supposed from the instances of its observation, and has perhaps escaped notice from its small size, and from the general ignorance of the distinction, not only of this, but of the ordinary species of tapeworms.

A more complete account of the subject of this communication will shortly appear in the American Journal of Medical Sciences.

May 13.

The President, Dr. Leidy, in the chair.

Fifteen persons present.

How Lycosa fabricates her Round Cocoon.—Dr. H. C. McCook said that while walking in the suburbs of Philadelphia lately, he found under a stone a female Lycosa (probably *L. riparia* Hentz), which he placed in a jar partly filled with dry earth. For two days the spider remained on the surface of the soil, nearly inactive. The earth was then moistened, whereupon (May 2) she immediately began to dig, continuing until she had made a cavity about one inch in depth and height. The top was then carefully covered over with a tolerably closely woven sheet of white spinning work, so that the spider was entirely shut in. This cavity was made against the glass side of the jar, and the movements of the inmate were thus exposed to view. Shortly after the cave was covered, the spider was seen working upon a circular cushion of beautiful white silk, about three-fourths of an inch in diameter, which was spun upwards in a nearly perpendicular position against the earthen wall of the cave. The cushion looked so much like the cocoon of the common tube-weaver, *Agalena nævia*, and the whole operations of the Lycosa were so like those of that species when cocooning, that the speaker was momentarily possessed with the thought that he had mistaken the creature's identity altogether, and again examined her carefully, only to be assured that she was indeed a Lycosa. After an absence of half an hour, Dr. McCook returned to find that in the interval the spider had oviposited against the central part of the silken cushion and was then engaged in enclosing the hemispherical egg-mass with a silken envelope. The mode of spinning was as follows: the feet clasped the circumference of the cushion, and the body of the animal was slowly revolved; the abdomen—now greatly reduced in size by the extrusion of the eggs—was lifted up, thus drawing out short loops of silk from the expanded spinnerets, which, when the abdomen was dropped again, contracted and left a flossy curl of silk at the point of attachment. The abdomen was also swayed back and forwards, the filaments from the spinnerets following the motion as the spider turned, and thus an even thickness of silk was laid upon the eggs. The same behavior marked the spinning of the silken button or cushion, in the middle of which the eggs had been deposited.

At this stage, Dr. McCook left for an evening engagement, with his ideas as to the cocooning habits of *Lycosa* very much confused, indeed, by an observation so opposed to the universal

experience. Returning to his desk in an hour and a half, he was once more assured by the sight of a round silken ball dangling from the apex of the spider's abdomen, held fast by short threads to the spinnerets. The cushion, however, had disappeared.

The mystery (as it had seemed to him) was solved: the Lycosa after having placed her eggs in the centre of the silken cushion, and covered them over, had gathered up the edges and so united them and rolled them as to make the normal globular cocoon of her genus, which she at once tucked under her abdomen in the usual way. This was a most interesting observation, and Dr. McCook thought had not before been made; at least Lycosa's manner of fabricating a cocoon had been heretofore unknown to him; and by reason of her subterranean habit the opportunity to observe it was rare. He had often wondered how the round egg-ball was put together, and the mechanical ingenuity and simplicity of the method were now apparent. The period consumed in the whole act of cocooning was less than four hours; the act of ovipositing took less than half an hour. Shortly after the egg-sac was finished, the mother cut her way out of the silken cover. She had evidently thus secluded herself for the purpose of spinning her cocoon. While feeding the spider some flies, the cave was accidentally filled up, and no effort had been made to dig another, although it is the custom of this genus, in natural environment, to remain pretty closely within such a habitation while carrying the cocoon.

One month after the above date (June 4), the spider was found with the young hatched, and massed upon her body from the caput to the apex of the abdomen. The empty egg-sac still clung to the spinnerets, and the younglings were grouped over the upper part of the same. The abdomens of the little spiders were of a light yellow color, the legs a greenish brown or slate-color, and the whole brood were tightly compacted upon and around each other, the lower layers apparently holding on to the mother's body, and the upper upon those beneath. Twenty-four hours thereafter, the cocoon-case was dropped, and the spiderlings clung to the mother alone. An examination of the cocoon showed that the young had escaped through the thin seam or joint formed by the union of the egg-cover with the circular cushion, when the latter was pulled up at the circumference into globular shape. There was no flossy wadding within—as is common with orb-weaving spiders, for example—nothing but the pinkish shells of the escaped young. On June 11, about one hundred of the spiderlings had abandoned the maternal perch, and were dispersed over the inner surface of the jar, and upon a series of lines stretching from side to side. About half as many more remained upon the mother's back; but by the 13th, all had dismounted. Meantime, they had increased in size at least one-half, apparently without food.

Note on the Amphibious Habit of Lycosa.—Dr. McCook alluded to another interesting fact in the life-history of *Lycosa*, brought to his attention by Mr. Alan Gentry. This gentleman, during the winter, visited a pond in the vicinity of Philadelphia (Germantown) which was frozen over. He cut a slab from the ice about eight to ten feet from the bank, and was surprised to see several spiders running about in the water. They were passing from point to point by silken lines stretched underneath the surface between certain water-plants. Several were captured, but unfortunately the specimens were not preserved. Mr. Thomas G. Gentry, who saw them, says that they were Lycosids, and from his description of the eyes he is evidently correct. It is a remarkable and novel fact to find these creatures thus living in full health and activity in mid-winter *within* the waters of a frozen pond, and so far from the bank in which the burrows of their congeners are so commonly found. It has been believed, heretofore, and doubtless it is generally true, that the Lycosids winter in deep burrows in the ground, sealed up tightly to maintain a higher temperature. But the above observation opens up a new and very strange chapter in the winter behavior of these spiders, as well as in the amphibious nature of their habits.

Pentastomum proboscideum.—Prof. Leidy exhibited specimens of this parasite, presented to him by Mr. Norman Spang, of Etna, Pa., who recently obtained them in Florida, from the lung of a large rattlesnake, *Crotalus adamanteus*.. They are cylindrical incurved, annulated, largest and rounded at the head, tapering behind, and becoming again larger and rounded at the end; and terminating ventrally in a short conical point. There are six of them, with the following measurements:—9 lines long by 1½ lines at the head; 13 lines by 1½ lines; 24 by 2½; 28 by 2½; 30 by 3, and 31 by 3. The species was first found by Humboldt in *Crotalus horridus*. It is common in the *Boa constrictor*, in which Professor Leidy had also observed it several times. It has likewise been found in a number of other serpents. Other species occur in different mammals, including man, reptiles and fishes. These singular parasites are regarded as the most degraded form of arachnida, in the mature stage being reduced to a worm-like, limbless body.

May 20.

Mr. Thomas Meehan, Vice-President, in the chair.

Eighteen persons present.

The Nature of a Fasciated Branch.—At the meeting of the Botanical Section on the 12th, Mr. Thomas Meehan called attention to a paper contributed by him to the *Proceedings of the*

American Association for the Advancement of Science, p. 277, vol. xix, 1870, in which, contrary to the accepted hypothesis that a fasciated branch was due to "over-luxuriance," or a high condition of vitality, he showed that the result was due to a degradation of vital power. A number of phenomena conceded to result from low vital conditions, were shown to be inseparably connected with fasciation, the essential feature of which is the production of an extraordinary number of buds, with a corresponding suppression of the normal internodal spaces.

This is precisely the condition of a flowering branch; and all its attendant phenomena find their analogue in a fasciated stem. Taking a composite flower in illustration—a sunflower, for instance—we find on the receptacle a coil of many hundred florets, each floret with a chaffy scale at the base. Each of these florets in morphology represents a branch, and the scale a leaf or bract, from the axil of which the branch would have sprung. If we imagine the head uncoiled, and everything in a normal vegetative condition, as distinct from the condition of inflorescence, we might have a sunflower plant a hundred feet high or more. But with the approach to the flowering stage we have a suppression of vegetative development, with a highly accelerated development of buds, out of which are morphologized the floral parts.

The receptacle on which the involucral scales and other parts of inflorescence in a compound flower, had also its analogue in the thickened stems which bore the buds in a fasciated branch.

The phenomena which indicated low vital power in the fasciated branch, were all manifested in a flower. Taking the test of vital power as the ability to retain life under equal circumstances, we find the leaves on a fasciated branch dying before those on the rest of the tree. On the balsam fir, an evergreen, the leaves are wholly deciduous; or a deciduous ally, the larch, the leaves mature before the others. On other trees we find always the leaves enduring longer than those on the fasciated. We say the leaves on the latter have a lower vital power. In severe winters the branches in the fasciation wholly die, in many cases, while those on other portions of the tree survive, and again we say, because they have a lower vital power. Precisely the same circumstances attend inflorescence. The leaves in their procession from a normal condition to petals lose this evidence of vitality in proportion to the degree of transformation. The petal dies before the sepal, the sepal before the bract, and the bract before the leaves, in the general order of anthesia, in a compound flower, though there are cases where, secondary causes coming into play, this rule would be reversed, but, in a general way, the soundness of the point would not be disputed.

From all these facts in analogy it might be said in addition to the points brought out in the paper of 1870, above cited, that *a fasciated branch is an imperfect and precocious attempt to enter on the flowering or reproductive stage.*

On Rapid Changes in the History of Species.—Mr. THOMAS MEEHAN exhibited flowers of the remarkable *Halesia* noted at page 32, and remarked on the wide divergence reached without any intervening modifications from the original, and observed that it was another illustration of what he thought must now be generally accepted, that the maxim of Ray "*Natura non facit saltum*" itself needed modification. He had called attention to this particular departure, among others, in a paper before the *American Association for the Advancement of Science*, in 1874;[1] what he desired to do now was to emphasize a few of the points brought out prominently in that paper, that "Variations in species, as in morphological changes in individuals, are by no means by gradual modifications; that suddenly formed and marked variations perpetuate themselves from seeds, and behave in all respects as acknowledged species; and that variations of similar characters would appear at times in widely separated localities."

In addition to the illustrations given in that paper, a remarkable one was afforded by the *Richardia æthiopica*, the common "calla" of gardens, the present season. Some four inches below the perfect flower a mere spathe was developed, partially green, but mostly white, as usual, but in this case we do not call it a spathe, but a huge bract. In other words, the usually naked flower-scape of the *Richardia* had borne a bract. Flowers with a pair of more or less imperfect spathes were not uncommon in some seasons; the peculiarity of the present season was the interval of several inches on the stem, which justified the term of bract to the lower spathe. From the vicinity of Philadelphia numbers had been brought to him, and others had been sent from Ohio, Indiana and Illinois—some hundreds of miles apart. What was the peculiarity in this season over others which induced the production of this bract, was one question. Whatever it may have been, it operated in bringing about a change of character, without the intervention of seed, directly on the plant, and in many widely separated places at the same time. What is to prevent a law which operates exceptionally in one season, operating again and in a regular and continuous way? So far as we can understand there can be no reason; and, if it should, we have a new species, not springing from a seed, or one individual plant—constituting one geographical centre of creation from which all subsequent descendants emigrated and spread themselves—but a whole brood of new individuals already widely distributed over the earth's surface, and entirely freed from the "struggle for existence" which the development of a species from a solitary individual presupposes.

Aside from the great value of this illustration of how the whole character of a species might be modified simultaneously

[1] See Proc. Amer. Assoc. Ad. Science, vol. xxiii, p. B. 9.

over a wide extent of country, it afforded a lesson in environment. External circumstances may influence modification, but only in a line already prepared for modification. This must necessarily be so, or change would be but blind accident, whereas palæontology teaches us that change has always been in regular lines, and in co-ordinate directions which no accident has been able to permanently turn aside. Just as in the birth of animals, we find, that however powerful may be some external law of nutrition, which, acting on the primary cell of the individual decides the sex, yet we see that no accident has been able to disturb the proportion of the sexes born, which has always been, so far as we know, nearly equal. So in the birth of species, making all allowance for the operation of environment, the primary plan has been in no serious way disturbed; we have to grant something to environment in the production of new forms, but only as it may aid an innate power of change, ready to expend itself on action as soon as the circumstances favor such development—circumstances which after all have very little ability to determine what direction such change shall take.

We know that distinct forms do spring through single individuals from seed, and that, after battling successfully with all the vicissitudes of its surroundings, a new form may succeed in spreading, through the lapse of years or ages, over a considerable district of country. But the idea that always and in all cases species have originated in this manner, presents, occasionally, difficulties which seem insurmountable. In the case of the similarity between the flora of Japan and that of the eastern portion of the United States, we have to assume the existence of a much closer connection between the land over what is now the Pacific Ocean, in comparatively modern times, in order to get a satisfactory idea of the departure of the species from one central spot; and to demand a great number of years for some plants to travel from one central birthplace before the land subsided, carrying back species in geological time further, perhaps, than mere geological facts would be willing to allow. But if we can see our way to a belief that plants may change in a wide district of country simultaneously in one direction, and that these changes once introduced, be able to perpetuate themselves till a new birth-time should arrive, we have a great advancement towards simplifying things.

May 27.

Mr. J. H. Redfield in the chair.

Twenty-three persons present.

Mr. Henry N. Rittenhouse was elected a member.

The following were ordered to be printed:—

NEW FOSSILS FROM THE FOUR GROUPS OF THE NIAGARA PERIOD OF WESTERN NEW YORK.

BY EUGFNE N. S. RINGUEBERG.

MEDINA GROUP.

Sphirophyton archimedes (n. sp.). Pl. II, fig. 1.

Frond large, thick; growing in loose spirals that gradually decrease in size from below upwards; about two coils occur in the space of the diameter.

Surface on both sides crossed by broad, irregular, gently undulose, wavy plications, which radiate from the centre out towards the obtuse rounded margins in subspiral curves, which traverse about one-fourth of the coil, following the general spiral growth, which is sinistral.

This fucoid is specially remarkable for its thickness and loose spiral growth. It differs from those figured by Hall by growing in decreasing spirals instead of expanding from below up.

From the upper friable bands of the Medina sandstone at Lockport.

CLINTON GROUP.

TRIACRINUS (n. gen.).

Calyx symmetrical, subelongate, ovoid to pyriform.

Basals five, arranged in a bilaterally symmetrical series, the median of which is placed to the right of the anal, and is pentagonal; the two next on either side are low quadrangular, and the outer adjoining two, which are wider than the others, are pentagonal and have their superior apices directed away from each other.

The second ring is tripartite and comprised of the large anal and the lower elongated and expanded portion of the two lateral anterior radials.

Anal very large, forming nearly one-third of the circumference of the calyx; equilaterally heptagonal; it rests on one of the quadrangular radials and laterally against the sloping sides of two adjacent pentangular ones.

The third or true radial ring is equally quinquepartite and has with the second ring—which is really but a modified portion of the third—a bilateral symmetry, but differing from that of the

basals in its axis, which is governed by the anal. Plates five, three small and two large, of subequal sizes; upper portion incurved so as to form part of the brim of the dome; deeply excavated above in the incurved portion, with dove-tailed notches to receive the brachials; first two radials on the posterior side small, resting on the sloping sides of the anal and the posteriorly expanded portion of the next radials; lateral radials much elongated, so as to rest upon the basals; and have the elongated portion much expanded, especially anteriorly, where they meet under the anterior radial: anterior radial small, supported by the lateral radials upon their expanded portion, which in the dextral one is supported by three basals like the anal, while the other rests on the two wider pentagonal basals and consequently has an acute inferior angle instead of a truncate one.

This anomalous genus should probably be placed next to *Hybocrinus* with which it has some slight affinity.

So far found only in the Clinton Group.

Triacrinus pyriformis (n. sp.). Pl. III, fig. 1.

Calyx small, subpyriform.

Base broad, truncate, with a slight, flat, wide depression to receive the column which was here evidently about as broad; leaving only a fine sharp projecting marginal ring.

Height to width as three to two.

Basals medium; first to the right of anal; acutely pentagonal, height and width about equal; the quadrangular plates are about one-half as high as the pentagonal ones; height to width as one to two; the two adjoining pentagonal plates are as high as the other, and are wider than high; extending nearly half way around the basal ring.

Second ring equally trichotomous. Anal large, slightly wider than high.

First two posterior radials medium, obversely equiform with their lower and external lateral sides curving outwards; lateral large radials slightly expanded posteriorly and widely anteriorly; anterior radial equilateral, with lateral angles fitting into the expanded radials upon which it rests. The wide dove-tailed incisions to receive the brachials are about two-thirds as wide as the upper part of the plates, at their lower expanded portion; above which point the upper part of the plate is rather abruptly

incurved. Height three-eighths inch. From the limestone of the upper portion of the Clinton Group at Lockport.

Triacrinus globosus (n. sp.) Pl. III, fig. 2.

Calyx small, globosely subovoid; base large, deeply excavated with rounding margins; sides evenly rounding from the base to the lateral apices of the incurved projections of the radials.

Basals incurved to receive the column, low at the sutures; quadrangular basals very low, height to width as one to three; about one-half of their height is incurved into the excavated base.

Anal large, almost as high as wide.

Expanded portion of the lateral radials wide, forming more than two-thirds of the second ring.

Anterior radial evenly rounding from the lateral sides to an acute inferior angle.

Expanded portion of the brachial notches about one-half as wide as the plate at that point.

The specific features of this species in comparison with the other, are the ovoid calyx, much more deeply excavated and rounded base, narrower brachial notches in the radials, and the evenly rounded sides of the small anterior radial. Height same as last species; width nearly equal to the height. The specimen from which the description is taken is slightly distorted by pressure.

Locality and group the same as *T. pyriformis.*

Stictopora obliqua (n. sp.) Pl. II, fig. 2.

Flat, large, broad and long, of equal width; with a central band of upward-curving rounding lines of growth, which are irregular in distance from each other, and as regards strength; they occupy from one-third to one-half of the surface, and are sometimes deflected slightly to one side or the other; the outer ends of these striæ of growth gradually disappear as they curve downwards and approach each other upon the flat, unstriated margins; but occasionally one or two striæ are more prominent than the rest, and extend further downwards and outwards.

Cells arranged in longitudinal and rectangular transverse rows on the unstriated marginal thirds; from which point the transverse rows are deflected downwards, and meet with a rounding curve in the central portion.

The cells of the outer portions are sub-rhombic, with an outward inclination of their outer upper corners; deflected rows of

cells rhomboid, becoming gradually quadrangular towards the centre.

FUNGISPONGIA (n. gen.)

Flattened; spreading from a fixed point; thinning out at the margin.

From the attached portions, numerous perforations, with smooth walls, radiate and branch out with many bifurcations and anastomoses in all directions towards the periphery, having numerous communications with the outer surface, which is quite smooth.

Fungispongia irregularis (n. sp.) Pl. III, fig. 3.

Flat, rather thin, irregularly spreading from a lateral or excentric point of growth. Surface moderately convex; rather abruptly beveled off to a sharp margin, which is somewhat irregular in contour. Internal structure consisting of small, closely arranged radiating perforations, which, though apparently of a quite regular circular form separately, are very irregular in section, in consequence of the frequent bifurcations and intercommunications occurring in their outward course. They do not always open directly upon the rather smooth surface, but are directed outwards towards the margin and frequently end in furrows on the outside.

The specimen from which this description is taken, is somewhat weathered in the central part, so as to well show its structure. From the siliceous bands of the Clinton at Lockport.

NIAGARA TRANSITION GROUP.

Stictopora graminifolia (n. sp.). Pl. III, fig. 4.

Very long and narrow, ribbon-like; width one-eighth inch, even throughout, flat on the noncellular and slightly convex on the cellular side.

The striæ of the lines of growth are abruptly arched in the centre, where they are accompanied by undulations of the surface having the same general curve, but which are confined to the central portion; the striæ grow more crowded as they gradually approach the margin, which they continue to do for a distance about equal to the width of the flat surface, where they become lost just before reaching it by being merged with others in common longitudinal striæ, which extend some distance down the side before they become finally lost.

Central third occupied by five or six longitudinal rows of cells, which continue throughout its entire length; from these the lateral cells are directed in nearly straight lines obliquely outwards and upwards towards the margins, at an acute angle. Cells twice as long or longer than their width and are arranged irregularly in the rows, without any apparent order.

The length of the specimen is two and one-fourth inches, which was not its entire length, several fragments having been lost off either end.

From the compact, fine-grained Niagara Transition Group limestone, which was described by me in the *American Naturalist*, Sept., 1882, at Gasport.

NIAGARA GROUP.

Eucalyptocrinus inconspectus (n. sp.). Pl. III, fig. 5.

Calyx large, cup-shaped, wide, upper part with perpendicular sides; base rounding, obconical with a small excavation to receive the column.

Column and arms unknown.

Surface finely rugose; rugæ giving evidence of irregular radiations from the centre of the larger plates.

Basals concealed within the depression to receive the column. First radials medium, rapidly expanding. Second radials large, as high as wide. The rest of the plates, excepting the elongate interradials and interbrachials, wider than high. Radial plates, with the exception of the second, flattened or even slightly depressed, slightly wider than high.

This species may be distinguished from *E. crassus* by the, comparatively, very shallow basal excavation which receives the column; also by the finely rugose surface-markings, the rounding base and nearly parallel sides at the upper part of the calyx. And from *E. decorus* by the longer calyx and surface-markings.

From the Niagara limestone at Lockport.

Cornulites contractus (n. sp.). Pl. III, fig. 6.

Shell much elongated, cylindrical or subcylindrical, very gradually tapering; regularly sharply annulate; longitudinally finely striate.

Growing attached to foreign bodies or in groups when young.

Annulations very sharply defined, equidistant; about five to

one-fourth inch in the larger specimens; they rise by an even curve from the rounded, contracted, inter-annular spaces and form sharp angular annulations.

Longitudinal striations prominent, closely arranged, and are strongest at the bottom of the trough-like depressions, having there the appearance of being minute plications produced by the contraction; they grow fainter at the apex of the annulations, but continue over them to the next. The sloping sides of the annulations sometimes bear one or two inconspicuous annulations which do not interfere with the contour of the shell.

The prominence and regularity of the annulations in the older portions of the shell will serve to distinguish it from *C. proprius*, with which it is associated, and to which it sometimes bears a superficial resemblance in the younger attached part.

From the Niagara shale at Lockport.

Cornulites nodosus (n. sp.). Pl. III, fig. 7.

Shell small, elongate, tapering gradually to an attenuate, very sharp apex.

Growing on small foreign bodies; attached throughout. Surface smooth, ornamented by numerous closely arranged nodes, which increase in size as the shell enlarges, and are placed in regular rows across it; the terminal ones being somewhat elongate and attached to the surface upon which it grows.

The largest specimen found measures five thirty-seconds of an inch in length.

From the Niagara shale at Lockport.

Lingula bicarinata (n. sp.) Pl. III, fig. 8.

Shell small, ovoid in outline; beak very acute; transverse diameter widest half way from the beak; valves evenly rounding, convex; with two hardly perceptible parallel median ridges commencing at the beak and extending to the outer margin, widening regularly as the shell increases in size.

Concentric striæ fine, even, increasing regularly by several bifurcations.

From the Niagara Shale at Lockport.

The specimens described were all collected by myself, and the types are in my collection.

EXPLANATION OF PLATES.

PLATE II.

1. *Spirophyton archimedes* (n. sp.)
   Two whorls of a large specimen, natural size.

1 *a*. Lower side of a part of a smaller frond, showing more plainly the subspiral undulations.

2. *Stictopora obliqua* (n. sp.)
   Natural size.

2 *a*. A small portion of it enlarged, showing the oblique downward curve of the transverse rows; three diameters.

PLATE III.

1. *Triacrinus pyriformis* (n. gen. et sp.); natural size.
   a. Posterior side; enlarged three diameters.
   b. Anterior side; enlarged three diameters.
   c. Basal view; enlarged three diameters.
   d. Upper side; enlarged three diameters.
   e. Diagram of plates.

2. *Triacrinus globosus* (n. sp.)
   The lettering of the figures same as last.

3. *Fungispongia irregularis* (n. gen. et sp.)
   a. Section; enlarged three diameters.

4. *Stictopora graminifolia* (n. sp.)
   a. Portion; enlarged three diameters.

5. *Eucalyptocrinus inconspectus* (n. sp.)

6. *Cornulites contractus* (n. sp.)
   a. A group of three individuals growing together.
   b. Surface of 6; enlarged three diameters.

7. *Cornulites nodosus* (n. sp.)
   a. Same individual; enlarged three diameters.

8. *Lingula bicarinata* (n. sp.)
   Interior of valve.

JUNE 3.

Mr. EDWARD POTTS in the chair.

Fifteen persons present.

A paper, entitled "On the Mutual Relations of the Hemibranchiate Fishes," by Theodore Gill, was presented for publication.

Opposite Leaves in Salix nigra.—At the meeting of the Botanical Section on June 2, Mr. THOMAS MEEHAN remarked that few botanists would expect to find opposite leaves in *Salix;* but in *S. nigra* Marshall, they appear at a certain stage of growth, which has much significance. This species is of that section which has the flower coætaneous with the leaves; that is to say, instead of the aments being sessile they terminate short branches. They are, however, not absolutely terminal, but appear so by the suppression for a time of the terminal bud. In the case of the female ament this terminal bud usually starts to grow very soon after the flowers mature, and forms a second growth, when the fertile catkin or raceme of fruit, becomes lateral. It is the first pair of leaves on this second growth that is opposite—all the rest are alternate as in the normal character of the genus. The leaves are so uniformly opposite under these circumstances, that there must be some general law determining the condition, which has not yet been developed.

JUNE 10.

Mr. GEO. W. TRYON, JR., in the chair.

Fourteen persons present.

A paper, entitled "On the Anacanthine Fishes," by Theodore Gill, was presented for publication.

JUNE 17.

Rev. H. C. McCOOK, D. D., Vice-President, in the chair.

Thirteen persons present.

A Spider that makes a spherical Mud-daub Cocoon.—The Rev. Dr. H. C. McCOOK said that in November, 1883, he received from Mr. F. M. Webster, Assistant State Entomologist of Illinois, two globular nodules of earth, about the size of a grape, which were thought to be the cocoons of a spider. Similar balls had often been found attached, by a slender thread or cord of silk, to the underside of boards laid down on the ground. From some of

these Mr. Webster had bred a parasitic ichneumon-fly. One box, in which mud-balls had been placed the preceding summer, was found by him in the autumn (November) to contain such parasites together with a number of young spiders, all dead. The spiders were not preserved, but the mud-balls were sent to the speaker for determination. One of these had an opening in the side about one millimetre in diameter from which evidently an ichneumon parasite had escaped. It contained the stiff, white cell commonly spun by the larva of this insect. The other resembled closely the spherical mud egg-nest of the wasp Eumenes, there being even a small nozzle at one pole, from which, however, unlike the mud-daub of the wasp, a slight silken cord protruded. Dr. McCook was much puzzled to decide upon the nature of these objects, but on the whole believed them to be the work of some hymenopterous insect, and not of a spider. Two ichneumons, which emerged from similar cells, were determined by Mr. E. T. Cresson to be *Pezomachus meabilis* Cresson.

Subsequently Mr. Webster sent other specimens, some of which were opened. They contained silken sacks imbedded in the centre of the mud-ball, apparently of spider spinning-work, and within these were fifteen or twenty yellowish eggs, evidently of a spider. This, of course, modified the speaker's view, and he set aside the specimens, of which he had now a number, in the hope of hatching out the contents. The disjecta membra of two adult spiders taken near the balls, though much broken, enabled him to determine them as Drassids (Drassoidæ, a family of the Tubeweavers), and probably of the genus *Micaria*. Mr. Webster simply found these *near* the mud-balls, but did not know that they had any connection with them. Dr. McCook moistened the cocoons in order to give a natural condition more favorable for the escape of the spiderlings, should they hatch, and May 30, 1884, on opening a box, he found about thirty lively young spiders therein. On the bottom of the box was a dead ichneumon, which had cut its way out of the side of one of the balls, by a round hole. The spiderlings seemed to have escaped from their ball along the slight duct left at the point where the bit of silken cord was imbedded in the hard earth, and thence protruded, forming the cocoon-stalk by which the ball was attached to an undersurface. The appearance of the spiderlings indicated that they had been hatched two or three days when first seen. They were Drassids, evidently the same species as the broken specimens above alluded to. Thus the interesting habit of concealing her future progeny within a globular cradle of mud was demonstrated to belong to a spider, as well as to a wasp. That this particular species is much subject to the attacks of hymenopterous parasites is already proved; but that it is more exposed than many other species which spin silken cocoons otherwise unprotected in the very same locality, does not appear. There is no evidence that so strange a habit has developed from necessity,

and none that it proves more protective than the ordinary araneal cocoonery.

Mr. Webster has found these mud-cocoons throughout the whole range of Illinois, a State of great longitudinal extent. Two balls from Southern Illinois are larger than the others, and composed of yellowish earth, but Dr. McCook had not yet succeeded in breeding anything from them. The balls from Central Illinois are made out of the rich black soil common to the prairies; the spiderlings hatched were from this section. He had named the species provisionally *Micaria limnicunæ* (*limnus*, mud; *cunæ*, a cradle), but thought it possible that Hentz may have described the species among some one of his genus *Herpyllus*. The young have pale yellow abdomens, of uniform color, and legs and cephalothorax of a uniform livid or stone-color. The adults (females) are of a uniform dark amber color; the cephalothorax glossy, leathery and smooth. The cephalic part is depressed below the thoracic part, sloping forward and downward. The body length is about one-fourth inch.

The only spider cocoons known to the speaker at all resembling those of Limnicunæ he had collected in a field at Alexandria Bay, New York, on the St. Lawrence River, 1882. They were attached by very loose spinning-work to the underside of stones. But the external case instead of being mud, was a mass of agglomerated particles of old wood, bark, leaves, blossoms, the shells and wings of insects, etc. These were evidently gnawed off, gathered and placed together, and then held in position by delicate and sparsely-spun filaments of silk. Two of these chip-balls were opened, and contained whitish cocoons similar to those in the mud-balls of Limnicunæ; another had within it the characteristic cell of some hymenopterous parasite, containing a dried-up pupa. A very thin veneering of yellow soil enclosed the silken case, but otherwise no mud was used. He put aside three specimens which remained, in the hope of hatching out and thus determining the species of the maker, but nothing ever appeared, and he had not wished to destroy such interesting specimens for the sake of knowing the condition of the interior. But on comparing these specimens with those of Mr. Webster as now before him, Dr. McCook believed that they were the work of closely related, or perhaps even the same species.

It is quite common for spiders of various and widely separated families to give their cocoons a protective upholstering of scraped bark, old wood, etc., and not unusual to find species that cover their egg-nests wholly or in part with mud. But the speaker was not aware that any species had yet been published as making cocoons like either of the above-described forms. He believed, therefore, that the facts were wholly new to science—certainly they were new to the field of American Araneology.

The following were ordered to be printed:—

ON THE MUTUAL RELATIONS OF THE HEMIBRANCHIATE FISHES.

BY THEODORE GILL.

§ 1. *Introductory.*

In my "Arrangement of the Families of Fishes," (1872, p. 13, 14) before I was aware of the peculiarities of the shoulder girdle, and only knowing the characters assigned to the order by Cope, I retained the Hemibranchii in the order Teleocephali, but in the introductory commentary (p. xxxix) I raised the group to ordinal rank, to which it seems entitled. Prof. Cope, however, is entitled to the credit of having first appreciated the distinctness of the group as a whole, although the characters assigned to it were not, perhaps, of the highest systematic value. As now understood, the order seems to be definable as follows:—

HEMIBRANCHII.

= *Hemibranchii*, Cope, Proc. Am. Ass. Adv. Science, v. 20, p. 338, 1872.
= *Hemibranchii*, Gill, Arrangement Families Fishes, p. xxxix, 1872 (Based on shoulder girdle).
= *Hemibranchii*, Cope, Proc. Am. Phil. Soc., v. 13, p. 25, 1873.
= *Hemibranchii*, Gill, Johnson's New Universal Cyclopædia, v. 2, p. 872, 1877 (defined).
= *Hemibranchii*, Jordan & Gilbert, Syn. Fishes N. Am., p. 387, 1882.
Acanthopterygii, fam., *auct. plur.*

In the "Arrangement of the Families of Fishes" (1872, pp. 13, 14), six families were recognized for the Hemibranchs, whose combinations and correspondence with the families of previous authors are shown in the following abstract:—

"(H. Gasterosteiformes.)

(Gasterosteoidea.)

133. *Gasterosteidæ* — *Gasterosteidæ*, Gthr., i, 1–7.
134. *Aulorhynchidæ* — *Aulorhynchoidæ*, Gill, P. A. N. S. Phil., 1862, 283.

(Aulostomoidea.)

135. *Aulostomidæ* — *Fistulariidæ*, Gthr., iii, 529, 535–538.
136. *Fistulariidæ* — *Fistulariidæ*, Gthr., iii, 529–534.

(H. Centrisciformes.)

137. *Centriscidæ*	*Centriscidæ*, Gthr., iii, 518–524.
138. *Amphisilidæ*	*Centriscidæ*, Gthr., iii, 518, 524–527."

In the "Introduction to the Study of Fishes" (1880, p. 507), Dr. Günther has referred the Aulorhynchoid fishes to the family Fistulariidæ.

In the "Synopsis of the Fishes of North America" (1882, p. 387), five families were recognized for American species by Messrs. Jordan & Gilbert, and grouped as follows :—

"* Bones of head produced into a long tube, which bears the short jaws at its end.

a. Body short, compressed, scaly; no teeth; spinous dorsal present. . . . . . *Centriscidæ*, 60.

aa. Body elongate; teeth present.

b. Dorsal spines none; a long caudal filament; no scales. *Fistulariidæ*, 61

bb. Dorsal spines present, disconnected; no caudal filament.

c. Body covered with ctenoid scales. *Aulostomatidæ*, 62.

cc. Body scaleless, with bony shields. *Aulorhynchidæ*, 63.

** Bones of head moderately produced; ventrals I, 1; dorsal preceded by free spines; body scaleless, naked or mailed. *Gasterosteidæ*, 64."

On a recent review of the forms of the order, I am more than ever convinced of the aptness of the classification proposed by myself in 1872 and submit the following table and characters which will, I think, amply justify that confidence. Far from being able to see any close affinity between the Aulorhynchidæ and Aulostomidæ, I am unable to appreciate any very distinctive differences from the Gasterosteidæ, and the close affinity between *Aulorhynchus* and *Spinachia* is such that I regard the family Aulorhynchidæ simply as a convenient one at the most, and as expressing the culmination in one direction of the tendency characteristic of the order. I should be scarcely disinclined to dissent from any who should combine the Gasterosteidæ and Aulorhynchidæ in one family.

§ 2. *Synopsis of Families.*

I. Dermal armature absent or developed only as plates on sides or back; vertebræ numerous (30 to 86); pubic bones connected with scapular arch; spinous dorsal represented by isolated spines.

1. Vertebræ anteriorly little enlarged; ventrals subthoracic, with enlarged spines (*Gasterosteoidea*).

a. Branchiostegal rays three; ventrals with one ray each; snout conic or but slightly tubiform. *Gasterosteidæ.*

b. Branchiostegal rays four; ventrals with four rays each; snout tubiform. . . . . . *Aulorhynchidæ.*

2. Vertebræ anteriorly (first four) elongate; ventrals subabdominal or near middle, without spines, but with 6 (or 5) rays (*Aulostomoidea*).

c. Dorsal spines developed, weak; body compressed, moderately long, with ctenoid scales. . . *Aulostomidæ.*

d. Dorsal spines undeveloped; body depressed or subcylindrical, very long, without scales (caudal with the two middle rays produced into a long filament). *Fistulariidæ.*

II. Dermal armature superficial, developed anteriorly and especially about the back; four anterior vertebræ much elongate; tail with its axis continuous with that of the abdomen; branchihyals and pharyngeals mostly present (fourth superior branchihyal and first and fourth superior pharyngeals only wanting); pubic bones not connected with the scapular arch; a spinous dorsal fin developed (*Macrorhamphosoidea*). . . . . . . *Macrorhamphosidæ.*

III. Dermal armature connate with the internal skeleton, and developed as (1) a dorsal cuirass in connection with the neuropophyses and (2) lateral shields connected with the ribs; vertebræ reduced; six or more anterior vertebræ extremely elongate, with normal articulations of centra; tail with its axis deflected from that of the abdomen by encroachment of a dorsal cuirass over the dorsal fin; branchial system feebly developed (fourth superior branchihyal and all the superior pharyngeals wanting); pubic bones not connected with the scapular arch; a spinous dorsal feebly developed under the posterior projection of the dorsal buckler. (*Amphisiloidea*) . . *Amphisilidæ.*

§ 3. *Diagnoses of Groups.*

GASTEROSTEIDÆ.

Synonyms as families.

< *Atractosomes*, Duméril, Zool. Anal., 14e fam., p. 124, 1806.
< *Acanti*, Rafinesque, Indice d'Ittiolog. Siciliana, 15. ord., p. 18, 1810.
< *Atractomia* (*Caranxia*), Rafinesque, Analyse de la Nature, 8e fam., p. —, 1815.
< *Scombéroides*, Cuvier, Règne Animal [1. ed.], t. 2, p. 311 (319), 1817.
< *Percoides?* Latreille, Fam. Nat. du Règne Animal, p. 135, 1825.
< *Centronotides*, Risso, Hist. Nat. de l'Europe Merid., t. 3, p. 426, 1826.
< *Zeidæ*, Swainson, Nat. Hist. and Class. Fishes, etc. v. 2, p. 241, 1839.
< *Triglidæ* (*Gasterosteini*), Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 32), 1832.
= *Gasterosteidæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 133, 1838; t. 4, p. 275, 1840.
= *Gasterosteidæ*, Girard, Expl. and Surv. for R. R. Route to Pacific Oc., v. 10, Fishes, p. 84, 1858.
= *Gasterosteoidei*, Bleeker, Enum. Sp. Pisc. Archip. Ind., p. xxiii, 1859.
= *Gasterosteidæ*, Günther, Cat. Fishes Brit. Mus., v. 1, p. 1, 1859.
= *Gasterosteoidæ*, Gill, Cat. Fishes E. Coast N. A., p. 39, 1861.
= *Gasterosteidæ*, Cope, Proc. Am. Assoc. Adv. Sci., v. 20, p. 338, 1872.
= *Gasterostei*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 34, 1873.
= *Gasterosteidæ*, Günther, Int. to Study of Fishes, p. 504, 1880.
= *Gasterosteidæ*, Jordan & Gilbert, Syn. Fishes N. Am., pp. 387, 392, 1833.
Percoides [?], Latreille, 1825.
Triglidæ, Subf. *Gasterosteini*, Bonaparte, 1832.

Hemibranchs with the anterior vertebræ little enlarged, a more or less fusiform body, conic or moderately produced snout, sides naked, or with a row of bony shields, and ventrals subthoracic, each with a large spine, and one or two rays.

Apeltinæ.

Gasterosteids with post-thoracic ventrals, pubic bones widely separated behind and extending on the sides, a moderately projecting snout, and a moderate caudal peduncle.

APELTES.

= *Apeltes* (Brevoort), Gill, Cat. Fishes E. Coast N. A., p. 39, 1861; Canad. Nat., n. s., v. 2, p. 8.
= *Apeltes*, Jordan, Man. Vertebrates Northern U. S., p. 249, 1876.
< *Gasterosteus*, Sauvage, Nouv. Arch. Mus. d'Hist. Nat. Paris, t. 10, pp. 7, 29, 1874. (Subgenus).

Apeltines with the branchial apertures restricted and three free dorsal spines.

Type, *A quadracus* = *Gasterosteus quadracus* Mitch.

Gasterosteinæ.

Synonyms as subfamilies.

< *Gasterosteini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 32), 1832; Nuovi Annali delle Sci. Nat., t. 2, p. 133, 1838; t. 4, p. 275, 1840.

< *Gasterosteinæ*, Gill, Cat. Fishes E. Coast N. A., p. 39, 1861; Canad. Nat., n. s., v. 2, p. 8, 1865.

Gasterosteids with post-thoracic ventrals, pubic bones connected and constituting a triangular median plate, a moderately projecting snout, and a moderate caudal peduncle.

EUCALIA, Jordan.

=*Eucalia*, Jordan, Man. Vertebrates Northern U. S., p. 248, 1876.

Gasterosteus sp., Kirtland, Agassiz, *et al.*

Gasterosteines with the branchial apertures confluent, and four or five non-divergent and equally reclinable free dorsal spines.

Type, *E. inconstans* = *Gasterosteus inconstans* Kirtland.

PYGOSTEUS.

< *Leiurus*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 242 (subgenus).

= *Pygosteus* (Brevoort), Gill, Cat. Fishes E. Coast N. A., p. 39, 1861; Canad. Nat., n. s., v. 2, p. 8.

= *Pygosteus*, Jordan, Man. Vertebrates Northern U. S., p. 249, 1876.

= *Gasterostea*, Sauvage, Nouv. Arch. Mus. d'Hist. Nat. Paris, t. 10, pp. 7, 29, 1874. (Subgenus).

Gasterosteus sp., Artedi, Linnæus, Lacépède, Cuvier, Fleming, Cuv. & Val., Girard, Günther, etc.

Gasteracanthus sp., Pallas.

Gasterosteines with the branchial apertures confluent (the branchiostegal membrane having a free inferior margin), and seven to eleven generally divergent spines.

Type, *P. pungitius* = *Gasterosteus pungitius* L.

GASTEROSTEUS.

< *Gasterosteus*, Artedi, Genera Piscium, p. 52, 1738.

< *Gasterosteus*, Linnæus, Syst. Nat., ed. x, t. 1, p, 295, 1758.

< *Gasterosteus*, Lacépède, Hist. des Poissons, t. 3, p. —, 1802.

< *Gasteracanthus*, Pallas, Zoographia Rosso-Asiatica, t. 3, p. 228 (1811), 1831,

< *Gasterosteus*, Cuvier, Règne Animal, 1re éd., t. 2, p. 300, 1817. (Subgenus).
< *Gasterosteus*, Fleming, Hist. Brit. Animals, p. 219, 1828.
< *Gasterosteus*, Cuvier & Valenciennes, Hist. Nat. des Poissons, t. 4, p. 479, 1829.
× *Gasterosteus*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 242, 1839.
× *Leiurus*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 242. (Subgenus).
< *Gasterosteus*, Girard, Expl. and Surv. for R. R. Route to Pacific Oc., v. 10, Fishes, p. 85, 1858.
< *Gasterosteus*, Günther, Cat. Fishes Brit. Mus., v. 1, p. 2, 1859.
= *Gasterosteus*, Gill, Cat. Fishes E. Coast N. A., p. 39, 1861; Canad. Nat., n. s., v. 2, p. 8, 1865.
< *Gasterosteus*, Sauvage, Nouv. Arch. Mus. d'Hist. Nat. Paris, t. 10, pp. 7, 9, 1874. (Subgenus.)
= *Gasterosteus*, Jordan, Man. Vertebrates Northern U. S., p. 248, 1876.

Gasterosteines with the branchial apertures restricted (the branchiostegal membrane being attached below), and two free divergent spines.

Type, *G. aculeatus* L.

Spinachiinæ.

Synonymy.

Spinachianæ, Gill, Proc. Acad. Nat. Sc. Phila., v. 14, p. 233, 1862.
Spinachiinæ, Gill, Johnson's New Universal Cycl., v. 4, p. 558 (under "Stickle-back"), 1878.

Gasterosteids with a very projecting subtubiform snout, subabdominal ventrals, and elongated caudal peduncle.

SPINACHIA.

= *Les Gastrés* (*Spinachia*), Cuvier, Règne Animal, t. 2, p. 320, 1817.
= *Spinachia*, Fleming, Hist. Brit. Animals, p. 219, 1828.
= *Polycanthus*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 242.
= *Gastræa*, Sauvage, Nouv. Arch. Mus. d'Hist. Nat. Paris, t. 10, pp. 7, 29, 1874. (Subgenus).
Gasterosteus sp., Linn., et al.

Spinachiines of unique type.

Type, *S. vulgaris* = *Gasterosteus spinachia* Linn.

AULORHYNCHIDÆ.

Synonyms as family names.

= *Aulorhynchoidæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 14], p. 233, 1862.
= *Aulorhynchidæ*, Gill, Arrangement Families Fishes, p. 14, 1872.

= *Aulorhynchidæ*, Jordan & Gilbert, Syn. Fishes, N. Am., pp. 387, 391, 1883.

Fistulariidæ, gen., Günther.

Synonym as subfamily name.

= *Aulorhynchinæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 13], p. 169, 1861.

Hemibranchs with the anterior vertebræ little enlarged, an elongated subcylindrical body, elongated tubiform snout; sides with a row of bony shields, and ventrals subthoracic, with a spine and four rays each.

AULORHYNCHUS.

= *Aulorhynchus*, Gill, Proc. Acad. Nat. Sc. Phila. [v. 13], p. 169, 1861.

= *Auliscops*, Peters, Monatsber. K. Preuss. Akad. Wiss., 1866, p. 510, 1866.

Aulorhynchids with a smooth-skinned crown and tube, lateral plates unarmed and hidden in the skin, dorsal spines (25–26) moderately short, and naked back.

Type, *A. flavidus* Gill.

AULICHTHYS.

= *Aulichthys* (Brevoort), Gill, Proc. Acad. Nat. Sci. Phila. [v. 14], p. 234, 1862.

Aulorhynchus sp., Steindachner.

Aulorhynchids with a corrugated crown and rostral tube, lateral plates each armed with a longitudinal posteriorly spinous ridge, dorsal spines (about 25) very short and transversely triangular, and reclining in grooves, behind each of which is a small plate.

Type, *A. Japonicus* (Brev.) Gill.

AULOSTOMIDÆ.

Synonymy.

< *Aulostomides*, Latreille, Fam. Nat. du Règne Animal, p. 129, 1825.

< *Aulostomatidæ*, Cantor, Cat. Malayan Fishes, p. 211, 1850.

= *Aulostomatoidei*, Bleeker, Enum. Sp. Piscium Archip. Ind., p. xxiii, 1859.

< *Aulostomatoids*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 13], p. 168, 1861.

= *Aulostomidæ*, Gill. Arrangement Families Fishes, p. 14, 1872.

< *Aulostomateidæ*, Cantor, Day, Fishes of India, v. 1, p. 360, 1878.

= *Aulostomatidæ*, Jordan & Gilbert, Syn. Fishes N. Am., pp. 387, 390, 1883.

Bouches en flute, gen., Cuvier.

Fistularidæ, gen., Günther, et al.

Hemibranchs with the first four vertebræ elongated, the form elongated compressed, with an elongated tubiform mouth; the body covered with cycloid scales, with subabdominal ventrals composed of six rays but without spines, and with a series of dorsal spines.

AULOSTOMA.

= *Aulostoma*, Lacépède, Hist. Nat. des Poissons, t. 5, p. 357, 1803.
< *Polypterichthys*, Bleeker, Natuurk. Tijdschr. Nederlandsch Indie, v. 4, p. 608.
Fistularia sp., Linn.
Solenostomus sp., Gronow.

Aulostomids with a much compressed body, rudimentary teeth, 8–12 dorsal spines, opposite oblong dorsal and anal (with 23–28 rays each), and a cuneiform caudal.

Type, *A. chinensis* = *Fistularia chinensis* Linn.

FISTULARIIDÆ.

Synonyms as family names.

< *Siphonostomes*, Duméril, Zool. Anal., 23e fam., p. 138, 1806.
Centrischini? Rafinesque, Indice d'Ittiologia Siciliana, p. 34, 1810.
< *Siphostomia* (*Aulostomia*), Rafinesque, Analyse de la Nature, 20e fam., p. —, 1815.
< *Bouches en flute*, Cuvier, Règne Animal [1re éd.], t. 2, p. 348, 1817; 2e éd., t. 2, p. 267, 1829.
< *Aulostomides*, Latreille, Fam. Nat. du Règne Animal, p. 129, 1825.
< *Centrisecides*, Risso, Hist. Nat. de l'Europe Merid., t. 3, p. 476, 1826.
< *Fistularidæ*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 35), 1832; Isis, 1833, col. 1200.
< *Scomberidæ* (*Fistularinæ*), Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 240, 1839.
< *Fistularidæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 132, 1838; t. 4, p. 190, 1840.
< *Fistularioidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, fam. 133, p. xxvi, 1859.
< *Fistulariidæ*, Günther, Cat. Fishes Brit. Mus., v. 3, p. 529, 1861.
< *Fistulariidæ*, Cope, Proc. Am. Assoc. Adv. Sc., v. 20, p. 339, 1872.
= *Fistulariidæ*, Gill, Arrangement Families Fishes, p. 14, 1872. (Named only.)
< *Fistulariæ*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 35, 1873.
< *Fistulariidæ*, Günther, Int. to Study of Fishes, p. 507, 1880.
= *Fistulariidæ*, Jordan & Gilbert, Syn. Fishes N. Am., pp. 387, 388, 1882.

Synonyms as subfamily names.

< *Fistularini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animal Vertebr. a Sangue Freddo, p. 35), 1832; Isis, 1833, col. 1200.

< *Fistularini*, Bonaparte, Nuovi Annale delle Sc. Nat., t. 2, p. 132, 1838; t. 4, p. 190, 1840.

= *Fistularinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 175, 240, 1839.

Hemibranchs with the first four vertebræ very long; a very elongated and somewhat depressed body; a long tubiform snout; without scales, with the ventrals near the middle, and having five or six rays each, but no spines, and without dorsal spines (the two middle rays of the caudal produced and united into a long filament).

FISTULARIA.

< *Solenostomus*, Klein.

< *Fistularia*, Linn., Syst. Nat., 10. ed., v. 1.

= *Fistularia*, Lac, Hist. Nat. des Poissons, t. 5, p. 349.

= *Channorhynchus*, Cantor, Cat. Malayan Fish., p. 211. (Proposed on account of preoccupation of Fistularia by Donati.)

Fistulariids of unique genus.

Type, *F. tabaccaria* Linn.

MACRORHAMPHOSIDÆ.

Synonyms as family names.

< *Aphyostomes*, Dumèril, Zool. Anal., 5. fam., p. 106, 1806.

= *Centrischini*, Rafinesque, Indice d'Ittiologia Siciliana, p. 34 (33, ord.[1]), 1810.

< *Siphostomia* (Aulostomia), Rafinesque, Analyse de la Nature, 20, fam., p. —, 1815.

< *Bouches en flute*, Cuvier, Règne Animal, t. 2, p. 348, 1817.

< *Aulostomides*, Latreille, Fam. Nat. du Règne Animal, p. 129, 1825.

< *Centriscides*, Risso, Hist. Nat. de l'Europe Merid., t. 3, p. 476, 1826.

< *Fistularidæ* (Centriscini), Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio. Distrib. Metod. Animal. Vertebr. a Sangue Freddo, p. 35), 1832; Isis, 1833, col. 1200.

< *Fistularidæ*, Bonaparte, Nuovi Annali delle Sc. Nat., t. 2, p. 132, 1838; t. 4, p. 190, 1840.

< *Fistularidæ*, Bonaparte, Cat. Metod. dei Pesci Europei, pp. 7, 70, 1846.

= *Centriscoidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxiii, 1859.

< *Centriscidæ*, Günther, Cat. Fishes Brit. Mus., v. 3, p. 518, 1861.

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[1] *Macroramphosus* is included in the 35. ord. *Siluridi* (p. 35.)

= *Centriscidæ*, Gill, Arrangement Fam. Fishes, p. 25, 1872.
< *Centrisci*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth.. p. 35, 1873.
= *Centriscidæ*, Jordan & Gilbert, Syn. Fishes N. A., p. 387, 1882.

Subfamily synonyms.

< *Centriscini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 35), 1832 ; Isis, 1833, p. 1200.
< *Centriscini*, Bonaparte, 1850.
= *Centriscinæ*. Gill, Proc. Acad. Nat. Sc. Phila., 1862, p. 234, 1862.
< *Orthichthyinæ*, Gill, Proc. Acad. Nat. Sc. Phila., 1862, p. 234, 1862.

Hemibranchs with the four anterior vertebræ much lengthened; bony plates anteriorly and especially about the back ; an elongated tubiform mouth ; abdominal ventrals with a spine and several rays; a small distinct spinous dorsal about the middle of the body ; with the branchihyals and pharangeals mostly present, the fourth superior branchihyal, and first and fourth superior pharyngeals only wanting.

MACRORHAMPHOSUS.

= *Macrorhamphosus*, Lacépède, Hist. Nat. des Poissons, t. 5, p. 136,
= *Centriscus*, Cuvier, Règne Animal, 1. ed., t. 2, p. 350, 1817.
> *Orthichthys*, Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 234, 1862.

Macrorhamphosids with an oblong body, graduating into the caudal peduncle, straight back, and about seven dorsal spines.

Type, *M. scolopax* = *Centriscus scolopax* Linn., 1766.

As Messrs. Jordan & Gilbert have recently shown (Proc. U. S. Nat. Mus., v. 5, p. 575, 1883), the *only* species referred by Linnæus at first to the genus *Centriscus*, was the *C. scutatus* (afterwards taken as the type of *Amphisile*), and consequently *Centriscus* cannot be properly used as the designation of the present genus. The name *Macrorhamphosus*, being the first applicable, although imposed by mistake, may be used for it. It is unfortunate that the change should have to be made, and, although fully conversant with the status years ago, I hesitated to propose it. Nevertheless with such excellent authorities as Messrs. Jordan & Gilbert to recognize its necessity, I no longer refuse to accede to the change.

CENTRISCOPS.

= *Centriscops*, Gill, Proc. Acad. Nat. Sci. Phila. 1862, p. 234, 1862.
Centriscus sp., Richardson, *et al.*

Macrorhamphosids with a deep body, abruptly contracted caudal peduncle, an excurrent peaked back, and about four to five dorsal spines.

Type, *C. humerosus* = *Centriscus humerosus* Richardson.

AMPHISILIDÆ.

Family Synonyms.

= *Amphisiloidei*, Bleeker, Enum. Sp. Piscium Archip. Ind., p. xvi, 1859; Atlas Ich. des Indes Néerland., t. 5, p. xv, 1865.
= *Amphisilidæ*, Cope, Proc. Am. Assoc. Adv. Sci., v, 20, p. 338, 1872.
= *Amphisilidæ*, Gill, Arrangement Families Fishes, p. 25, 1872.

Subfamily Synonym.

= *Amphisilinæ*, Gill, Proc. Acad. Nat. Sci. Phila. (v. 14). p. 234, 1862.

< *Centriscidæ*, pt., Günther, 1861.
< *Centrisci*, pt., Fitzinger, 1873.

Hemibranchs with six or more anterior vertebræ extremely elongated, the caudal much abbreviated, paired selliform dorsal plates connected with the neuropophyses of the dorsal vertebræ, and lateral ones developed in connection with the ribs, an elongated tubiform mouth, abdominal ventrals, two dorsals, and with the entire caudal portion of the body deflected downwards by the encroachment of the dorsal cuirass over the dorsal fins; and with the "fourth supra-branchihyal, and all the superior pharyngeals wanting" (Cope).

CENTRISCUS.

= *Centriscus*, Linn., Syst. Nat., 10. ed., v. 1.
< *Centriscus*, Linn., Syst. Nat., 12. ed., v. 1.
< *Amphisile* (Klein), Cuvier, Régne Animal, t. 2, p. 350, 1817.
= *Acentrachme*, Gill, Proc. Acad. Nat. Sci. Phila. (v. 14), p. 234, 1862.
= *Amphisile*, s. g. *Acentrachme*, Lütken, Vid. Medd. Naturhist. Fören. Kjöbenhavn, 1865, p. 215, 1866.

Amphisilids without a movable spine connected with the posterior process of the dorsal cuirass.

Type, *C. scutatus*.

AMPHISILE.

< *Amphisile*, Klein, Hist. Piscium Nat. promov. Miss., p. 28, 1744 (not binomial).
< *Amphisile*, Cuvier, Règne Animal, t. 2. p. 350, 1817.
= *Amphisile*, Gill, Proc. Acad. Nat. Sci. Phila. (v. 14), p. 234, 1862.
= *Amphisile*. s. g. *Amphisile*, Lütken, Vid. Medd. Naturhist. Fören. Kjöbenhavn, 1865, p. 215, 1866.

Amphisilids with a spine at the posterior process of the dorsal cuirass.

Type, *A. strigata* = *Amphisile* sp., Klein.

§ 4. *Extinct Families.*

In addition to these types, all represented in the existing faunas, there are two fishes no longer living, which cannot be referred to any of the families as now restricted, but appear to be types of peculiar ones. They are the *Urosphen fistularis* and *Rhamphosus aculeatus* of Agassiz; both have been found in the celebrated fish-beds of Mount Bolca. These have been referred to the family Fistulariidæ by Dr. Günther, but one of them is more nearly related to the Macrorhamphosidæ and Gasterosteidæ. They are imperfectly known, but appear to be distinguishable as family types by the following characters, which will doubtless be supplemented by others when well-preserved specimens or characteristic parts shall be critically examined.

UROSPHENIDÆ.

Hemibranchs with the first four vertebræ much elongate, a moderately elongated body, a long tubiform mouth (ventrals abdominal? dorsal unknown), and a very large cuneiform caudal.

RHAMPHOSIDÆ.

Hemibranchs with the anterior vertebræ normal (not elongated) and separate, about 22 (8 abdominal and 14 caudal) vertebræ in all, plates on the nape and shoulders only, with a tubiform mouth, subthoracic ventrals, a dorsal spine behind the nuchal armature, and the second dorsal and anal far behind and opposite.

§ 5. *The Pegasidæ.*

Finally, there is a family which has been shifted from place to place in the system, and which has been referred by Prof. Cope to the order Hemibranchii. Its type was regarded as a chondropterygian by Linnæus and the elders, as a syngnathoid fish by Cuvier; first isolated in a family by Latreille; received the family name Pegasidæ from H. Adams in 1854; was pronounced to be related to the Agonidæ by Steenstrup in 1866; placed next to them by Günther (Int., p. 482, 1880), and relegated to the Hemibranchii by Cope. It has also been regarded as the representative of a peculiar order ("ordo 12. Pegasi"), of the "sub-

legio" Lophobranchii by Bleeker, and as a suborder (Hypostomides) of the order Lophobranchii by A. Duméril. Having no skeleton to examine, I retain it in the present order solely on the authority of Prof. Cope, and with some doubt as to its right herein.

PEGASIDÆ.

Family Synonyms.

< *Sphærionidi?* Rafinesque, Indice d'Ittiolog. Siciliana, p. 40, 1810.
< *Pomanchia*, Rafinesque, Analyse de la Nature, 25. fam., 1815.
= *Hypostomides*, Latreille, Fam. Nat. du Règne Animal, p. 117, 1825.
< *Syngnathidæ*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 39), 1832; Isis, 1833, c. 97, 119.
< *Syngnathidæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 195, 331, 1839,
< *Syngnathidæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 130, 1838; t. 4, p. 185, 1840.
< *Hippocampidæ*, Nardo, Atti Congressi Scienz. Ital. rac. et ord., v. 1, p. 70 (1842), 1845.
= *Pegasidæ*, Kaup, Archiv für Naturg., 19. Jahrg., B. 1, p. 227, 1853; also Cat. Lophobr. Fishes Brit. Mus., p. 3, 1856.
= *Pegasidæ*, Adams, Manual Nat. Hist., p. 94, 1854.
= *Pegasoidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xv, 1859.
= *Pegasidæ*, Günther, Cat. Fishes Brit. Mus., v. 8, p. 146, 1870.
= *Pegasidæ*, Cope, Proc. Am. Assoc. Adv. Sci., v. 20, p. 339, 1872.
= *Pegasi*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 49, 1873.
= *Pegasidæ*, Cope, Proc. Am. Phil. Soc., v. 13, p. 25, 1873.

Subfamily Synonyms.

= *Pegasini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 39), 1832.
= *Pegasini*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, x, p. 130, 1838; t. 4, p. 186, 1840.
= *Pegasini*, Nardo, Atti Congressi Scienz. Ital. rac. et ord., v. 1, p. 70 (1842), 1844.
= *Pegasini*, Bonaparte, Catal. Metod. Pesci Europei, pp. 9, 89, 1846.*

Hemibranchs? with the snout projecting and the mouth inferior.

ON THE ANACANTHINE FISHES.

BY THEODORE GILL.

Under the name Anacanthini have been grouped those Teleost fishes which have "vertical and ventral fins without spinous rays; the ventral fins, if present, are jugular or thoracic; air-bladder, if present, without pneumatic duct" (Günther, Int. to Study of Fishes, p. 537, 1880). These characters are not re-inforced by any others, but nevertheless the fishes so characterized have been segregated by most ichthyologists into an "order." The propriety of such valuation was disputed by the present writer in 1861 (Cat. Fishes E. Coast N. Am., p. 7), and the group degraded to the rank of a suborder, and subsequently (Proc. Acad. Nat. Sc. Phila., 1863, p. 255), the genus *Zoarces* was transferred to it and associated with the Lycodinæ and Gymnelinæ in the same family. The American ichthyologists have generally acceded to the propriety of this degradation of the Anacanthini to subordinal rank. Most have also conceded the propriety of the association of *Zoarces* with the forms indicated, as has also Prof. Collett of Norway (Den Norske Nordhavs Expedition 1876–1878; Ficke, p. 78–79, 1880), although Prof. Cope has still retained *Zoarces* among the Blenniidæ. The subordinate rank of the Anacanthini appears indeed to be too evident to need further emphasis in this place, and its value as a suborder, or even as a natural and homogeneous group, may be justly questioned and denied. Nevertheless, for the sake of convenience at least, the collection may be provisionally (and only provisionally) preserved. The group under various names has been adopted by European authors, and the following are synonyms, exclusive of those pertaining to the Heterosomatous types.

JUGULARES OR ANACANTHINI.

Synonymy.

X [*Holobranches*] *Jugulaires*, Duméril, Zoologie Analytique, p. 111, 1806.
X [*Holobranches*] *Apodes*, Duméril, Zoologie Analytique, p. 117, 1806.
X *Chorizopia*, Rafinesque, Analyse de la Nature, p. —, 1815. (Suborder.)
X [*Tétrapodes*] *Jugulaires*, De Blainville, Journal de Physique, t. 83, p. 255, 1816. (Suborder.)
X [*Apodes*] ——— De Blainville, Journal de Physique, t. 83, p. 255, 1816.

× [*Malacoptérygiens*] *Subbranchiens*, Cuvier, Règne Animal, 1re ed., t. 2, p. 211, 1817. (Tribe.)
× *Jugulaires Malacoptérygiens*, Risso, Hist. Nat. de l'Europe, t. 3, p. 214, 1827. (Tribe.)
× *Apodes*, Risso, Hist. Nat. de l'Europe, t. 3, p. 189, 1827. (Order.)
× *Lotes*, Oken, Lehrbuch der Naturgeschichte, 1816.
× *Malacopterygii*, Bonaparte, Giorn. Accad. di Sci., v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 36), 1832; Isis, 1833, col. 1202.
× *Subbrachiani* (*Sternopygii*). Bonaparte, Giorn. Accad. di Scienze, v. 52, (Saggio Distrib. Method. Animali Vertebr. a Sangue Freddo, p. 37), 1832; Isis, 1833, col. 1202.
< *Malacopteryges*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 167, 197, 1839. (As order.)
< *Anacanthini*, Müller, Abhand. K. Akad. Wissensch. Berlin, 1844, p. 199, 1846. (As order.)
< *Gadi*, Bonaparte, Catalogo Metodico dei Pesci Europei, pp. 5, 22, 1846. (As order.)
< *Physoclysti*, Gill, Cat. Fishes E. Coast N. Am., p. 7, 1861. (As suborder of *Teleocephali*).
< *Anacanthini*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 317, 1862. (As order.)
< *Anacanthini*, Häckel, Generelle Morphologie der Organismen, B. 2, p. cxxvii, 1866. (As suborder.)
= *Anacanthini*, Gill, Arrangement Families Fishes, p. 31, 1872. (As suborder of *Teleocephali*.)
> *Anacanthini*, Cope, Proc. Am. Assoc. Adv. Science, v. 20, p. 341, 1872.
> *Scyphobranchii*, Cope, Proc. Am. Assoc. Adv. Science, v. 20, p. 341, 1872.
= *Anacanthini* or *Jugulares*, Jordan & Gilbert, Syn. Fishes N. Am., p. 783, 1882. (As group or suborder.)

Two open questions affect the constituency of the group.

Prof. Cope, in his memorable "Observations on the systematic relations of the Fishes", defined the group, which he referred to his "order" Percamorphi, in the following terms:—

1. "Anacanthini. Basis cranii simple, no tube; post-temporal bifurcate; scapular foramen between scapula and coracoid; superior pharyngeals three, horizontal, third little larger; dorsal fin rays flexible, jointed. Includes the families *Gadidæ* and *Macruridæ*, both with isocercal caudal vertebræ."

This definition is quite applicable to the typical *Gadidæ* and *Macruridæ*, but there are several forms which have generally been associated with them (and which have even been usually considered to be more nearly allied to the Gadidæ than are the

Macruridæ) which do not exhibit the combination of characters signalized. Such fishes have been designated as the families *Brotulidæ*, *Ophidiidæ*, *Fierasferidæ*, and *Congrogadidæ*. These have the characters assigned by Prof. Cope to his Scyphobranchii, at least as much as the genus *Zoarces* (referred to that group as a genus of Blenniidæ), but none of the genera are mentioned under either title. Probably Prof. Cope had no skeletons of any of the families in question. We are therefore left in doubt (1) whether he would associate them with the *Gadidæ* and *Macruridæ* and modify the characters of the including group Anacanthini, or (2) whether he would refer them to the Scyphobranchii, next to *Zoarces* and the *Blenniidæ* generally.

Messrs. Jordan & Gilbert, in their excellent "Synopsis of the Fishes of North America," incidentally (p. 783, in a foot-note) refer to the "Anacanthini or Jugulares" as a "group or suborder" of Acanthopteri, and conclude the "order Acanthopteri" with the series of families generally combined under the former name. After having first admitted the family *Brotulidæ* (p. 79), they finally referred its constituents to the family *Gadidæ* (p. 794), admitting, however, the families *Congrogadidæ* (p. 790), *Fierasferidæ* (p. 791), *Ophidiidæ* (p. 792), and *Macruridæ* (p. 810). The question now arises whether the last thought of the eminent ichthyologists is an advance on their first thought.

A preliminary investigation into the structure of the Jugular or Anacanthine fishes, leads us to different conclusions from those enunciated by the several great authorities, whose views we have mentioned. That lamentable inattention to anatomy, and poverty of the museums in anatomical preparations and skeletons, which is the opprobrium of the institutions of this country, has prevented anything like an exhaustive examination, and will forbid the rapid progress here of scientific ichthyology till the want is supplied. My own small private collection, supplemented by the data published by others, has alone rendered even the present outline of the system of the Anacanthini possible. The details will therefore have to be filled in when science shall have established itself more thoroughly here, or when a citizen of a more fortunate land shall take up the subject. Enough is now known, however, to almost assure us that the present outline cannot be far out of the way.

Thanks to the kindness of my venerable friend, Prof. Poey, of Havana, I obtained, many years ago, the cranium of the West Indian *Brotula* (*B. barbata*) and briefly indicated the most salient characteristics of the type in a foot-note to an article "On the Affinities of several doubtful British Fishes" (Proc. Acad. Nat. Sci. Phila., 1864, p. 200). The note, published in this rather irregular manner, has doubtless escaped the attention of Messrs. Cope, Jordan and Gilbert, for otherwise they would certainly have recognized the validity of the family Brotuliidæ. The type in question, indeed, has but little affinity with the Gadidæ, and it gives me a pleasure, the greater because it is so rare, to find myself in accord with Dr. Günther in combining it rather with the Ophidiina, Fierasferina and Congrogadina, in contradistinction to the Gadidæ. I must, however, entirely dissent from that gentleman in considering the combination as of simply family value, in associating with them the Ammodytina, and also as to the sufficiency of the diagnosis.

The several groups are distinguishable as follows:—

SUPERFAMILY GADOIDEA.

Synonymy.

> *Gadoidea*, Gill, Cat. Fishes E. Coast N. Am., p. 7. 1873. (Named only.)
> *Macruroidea*, Gill, Cat. Fishes E. Coast N. Am., p. 7, 1873. (Named only.)

Jugulares with the orbito-rostral portion of the cranium longer than the posterior portion, the cranial cavity widely open in front; the supraoccipital well developed, horizontal and cariniform behind, with the exoccipitals contracted forwards and overhung by the supraoccipital, the exoccipital condyles distant and feebly developed, with the hypercoracoid entire, the hypocoracoid with its inferior process convergent towards the proscapula, and the fenestra between the hypercoracoid and hypocoracoid.

GADIDÆ.

Family Synonyms.

< *Jugulaires* ou *Auchénoptères*, Duméril, Zoologie Analytique, p. 118, 1806.
< *Gadinia*, Rafinesque, Analyse de la Nature, p. —, 3e fam., 1815.
< *Metrosomes*, De Blainville, Journal de Physique, t. 83, p. 255, 1816.
× *Gadini*, Rafinesque, Indice d'Ittiolog. Siciliana, p. 11, 1810.
< *Gadoïdes*, Risso, Hist. Nat. de l'Europe Mérid., t. 3, pp. 104, 214, 1826.
< *Gadoïdes*, Cuvier, Règne Animal, 1re éd., 2, p. 211, 1817; 2e éd., t. 2, p. 330, 1829.

< *Gadites*, Latreille, Fam. Nat. du Règne Animal, p. 125, 1825.
< *Gadites*, Stark, Elements of Nat. Hist., v. 1, p. 423, 1828.
< *Gadites*, McMurtrie, Cuv. Animal Kingdom, v. 2, p. 243, 1831.
< *Gadidæ*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 37), 1832.
< *Gadoideæ*, Rich, Fauna B., Americana, v. 3, p. 241, 1836.
< *Gadidæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 299, 1839.
< *Gadidæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 132, 1838; t. 4, p. 194, 1840.
> *Brosmiidæ*, Adams, Manual Nat. Hist., p. 104, 1854.
> *Phycidæ*, Adams, Manual Nat. Hist., p. 104, 1854.
× *Merluciidæ*, Adams, Manual Nat. Hist., p. 104, 1854.
> *Gadidæ*, Adams, Manual Nat. Hist., p. 104, 1854.
< *Gadidæ*, Kaup, Archiv. für Naturgeschichte, Jahr. 1858, B. 1, p. 86, 1858.
< *Gadidæ*, Girard, Expl. and Surv. for R. R. Route to Pac. Oc., v. 10, Fishes, p. 140, 1858.
× *Gadoidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxvi, 1859.
< *Gadidæ*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 326, 1862.
< *Gadidæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, p. 247, 1863.
< *Gadidæ*, Cope, Proc. Am. Assoc. Adv. Sci., v. 20, p. 341, 1872.
= *Gadidæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.
< *Gadi*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 43. 1873.
< *Gadidæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 400, 794, 1882.

Subfamily Synonyms.

× *Merluccia*, Rafinesque, Analyse de la Nature. p. —, 1re S. fam., 1815.
< *Gadini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 37), 1832.
> *Gadinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 299, 1839.
× *Merluccinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 300, 1839.
> *Phycinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 301, 1839.
× *Brosminæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 301, 1839.
× *Gadini*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 1832, 138; t. 4. p. 194, 1840.
> *Lotini*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 132, 1838; t. 4. p. 194, 1840.
< *Gadinæ*, Kaup, Archiv für Naturgeschichte, Jahrg. 1858, B. 1, p. 86, 1858.
× *Gadiformes*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxvi, 1859.
> *Gadinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, pp. 229, 243, 248, 1863.
> *Lotinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, p. 230, 1863.

$>$ *Phycinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, p. 230, 1863.
$>$ *Ciliatinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, p. 230, 1863.
$>$ *Brosminæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, p. 230, 1863.
$=$ *Gadinæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 794, 1882.

Gadoidea with a moderate caudal region coniform behind, and with the caudal rays procurrent above and below; submedian anus, moderate suborbital bones, terminal mouth, jugular ventrals, dorsal furniture commencing nearly above the pectoral region, variously developed, and anal confined mostly to the posterior half of the length.

This group is, perhaps, still a composite one, and all the forms retained in it, otherwise called Gadinæ by Messrs. Jordan & Gilbert, do not have the "frontal bone single, normal." The Gadinæ, Phycinæ and Brosminæ (Gill, op. cit.) are thus characterized, and are typical constituents, but the Lotinæ, and apparently Ciliatinæ or Oninæ, have doubled or paired frontals. Unfortunately the only skeletons of these types accessible to me are articulated, and cannot be critically examined. It seems probable, however, that they may be segregated in a peculiar family.

MERLUCIIDÆ.

Family Synonyms.

$<$ *Merluciidæ*, Adams, Manual Nat. Hist., p. 104, 1864.
$=$ *Merluciidæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.
Jugulaires, gen., Duméril.
Gadinia, gen., Rafinesque.
Metrosomes, gen., Blainville.
Gadoides, gen., Risso.
Gadidæ, gen., Bon., Swains., Adams, Günther, Girard.
Gadoidei, gen., Bleeker.
Gadi, gen., Fitzinger.

Subfamily Synonyms.

$<$ *Merluccia*, Rafinesque, Analyse de la Nature, 1re S. fam., 1815.
$<$ *Merluccinæ*, Swainson, Natural History of Fishes, Amphibians and Reptiles, v. 2, pp. 118, 300, 1839.
$=$ *Merluciinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 14, pp. 243, 244, 1863.
$=$ *Merluciinæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 795, 1882.
Gadini, pt., Bon.
Gadinæ, pt.

Gadoidea with a moderate caudal region coniform behind and with the caudal rays procurrent forwards, the anus submedian, moderate suborbital bones, terminal mouth, subjugular ventrals;

dorsal double, a short anterior and long posterior one, a long anal corresponding to the second dorsal; *ribs wide, approximated, and channeled below or with inflected sides, and paired excavated frontal bones with divergent crests continuous from the forked occipital crest.*

BREGMACEROTIDÆ.

Synonymy.

= *Bregmacerotidæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.
Blenniidæ, gen., Richardson.
Gadidæ, gen., Günther, Day.

Gadoidea? with a robust caudal portion truncate or convex behind, almost without procurrent caudal rays above or below, with an antemedian anus, moderate suborbitals, terminal mouth, jugular ventrals abnormally developed; an occipital ray, and behind a continuous dorsal fin, confined to the caudal portion, and an anal nearly similar to the long dorsal.

RANICEPITIDÆ.

Family Synonyms.

= *New Family*, Parnell, Mag. of Zool. and Bot., v. 1, p. —, 1837. (Not named, but indicated.)
= *Ranicepitidæ*, Gill, Arrangement of Fam. of Fishes, p. 3, 1872.
Jugulaires, gen., Duméril.
Gadinea, gen., Rafinesque.
Gadoides, gen., Cuvier.
Gadidæ, gen., Bonaparte, *et al.*
Gadoidea, gen., Bleeker.
Gadi, gen., Fitzinger.

Subfamily Synonym.

= *Ranicepini*, Bonaparte.

Gadoidea? with a moderate caudal portion, coniform behind, and with caudal rays procurrent, submedian anus, moderate suborbital bones, terminal mouth, jugular ventrals, dorsal (typically) double, an anterior small and posterior long one, anal corresponding to second dorsal, and *rudimentary pyloric cæca in reduced number (2).*

MACRURIDÆ.

Family Synonyms.

< *Lophionotes*, Duméril, Zoologie Analytique, p. 129, 1806.
< *Trachinidi*, Rafinesque, Indice d'Ittiolog. Siciliana, p. 12, 1810.
< *Cephalosomes*, Blainville, Journal de Physique, t. 83, p, —, 1818.

= *Lépidoléprides*, Risso, Hist. Nat. des Poissons de l'Europe Mérid., t. 3, p. 242, 1826.

< *Gadoides*, Cuvier, Règne Animal, 1re éd., t. 2, p. 211, 1817; 2e éd., t. 2, p. 330, 1829.

= *Lepidolepridæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 179, 261, 1839.

= *Macruridæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 132, 1838; t. 4, p. 194, 1840.

= *Lepidosomatidæ*, Adams, Manual Nat. Hist., p. 101, 1854.

< *Gadoidei*, Bleeker, Enum. Sp. Piscium Archipel, Indico, p. xxvi, 1859.

= *Macruridæ*, Günther, Cat. Fishes Brit. Mus., v., 4, p. 390, 1862.

= *Macruridæ*, Cope, Proc. Am. Assoc. Adv. Sci., v. 20, p. 341, 1872.

= *Macruridæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.

= *Macrouri*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 43, 1873.

= *Macruridæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 400, 810, 1882.

Gadinia, gen., Rafinesque, 1815.

Gadidæ, s. fam., Bonaparte, 1832.

Gadoidei, s. fam., Bleeker.

Subfamily Synonyms.

< *Trachinia*, Rafinesque, Analyse de la Nature, p. —, 2e s. fam., 1815.

= *Macrourini*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 37), 1832.

= *Macrurini*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 132, 1838; t. 4, p. 194, 1840.

= *Macrurini*, Kaup, Archiv für Naturgeschichte, Jahrg. 1858, B. 1, p. 86, 1858.

= *Macrouriformes*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxvi, 1859.

Gadoidea with an elongated tail tapering backwards and destitute of a caudal fin, postpectoral anus, enlarged suborbital bones, inferior mouth, subbrachial ventrals, a distinct anterior dorsal, and a long second dorsal and anal converging on end of tail.

The several families thus defined are certainly, or in the case of the Ranicepitids and Bregmacerotids, presumably typical Anacanthines, and exhibit the cranial and scapular characteristics signalized for the superfamily Gadoidea. The group thus defined is quite a natural one and perhaps may be deemed worthy of continued isolation under the name Anacanthini or Jugulares, although the propriety of assigning to it subordinal rank is very doubtful.

How very different the other forms approximated to the group are, may be appreciated from the following diagnoses.

SUPERFAMILY OPHIDIOIDEA.

Synonymy.

> ***Brotuloidea***, Gill, Cat. Fishes E. Coast N. Am., p. 7, 1873. (Named only.)

> ***Ophidioidea***, Gill, Cat. Fishes E. Coast N. Am., p. 7, 1873. (Named only.)

Jugulares with the orbito-rostral portion of the cranium contracted and shorter than the posterior, the cranial cavity closed in part by the expansion and junction of the parasphenoid and frontals, the supraoccipital horizontal and cariniform posteriorly, the exoccipitals expanded backwards and upwards behind the supraoccipital, the exoccipital condyles contiguous, and with the hypercoracoid (scapula, Parker) fenestrate (or foraminate) about its centre, and the hypocoracoid with its inferior process divergent from the proscapula.

These characters are exhibited in the *Brotula barbata* (specimen in coll. T. G.), *Brosmophycis marginatus* (MSS. note), *Pteridium ater* (cranium behind, Emery,[1] f. 27), *Ophidium barbatum* (cranium above, E., f. 26 ; scapular arch, E., f. 44), *Fierasfer acus* (cranium, E., f. 18–22; scapular arch, E., f. 35–36), *Echiodon dentatus* (cranium, E., f. 23–25 ; scapular arch, E., f. 37–38), and *Encheliophis vermicularis* (scapular arch, E.,[1] f. 39). The osteology of the Congrogadidæ and Brotulophididæ is entirely unknown and it is only assumed that they belong to this group on account of general agreement in superficial characters.

BROTULIDÆ.

Synonyms as Family Names.

= ***Brotulidæ***, Adams, Manual Nat. Hist., p. 104, 1854.

< ***Brotuloidei***, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxv, 1859.

= ***Brotuloidæ***, Gill, Proc. Acad. Nat. Sci. Phila. [v. 15], p. 252, 1863.

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[1] The references indicated by "E.," are to Prof. Emery's excellent memoir on "Fierasfer" in the Atti della R. Accademia dei Lincei" 1879–80 (pp. 167–254, pl. 1*a*–9*a*). How useful and indeed indispensable this memoir has been may be judged from the references.

= *Brotuloids*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 16], p. 200, 1864 (cranial characters indicated).
= *Brotulidæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.

Gadoides, gen., Cuvier.
Gadidæ, gen., Bonaparte.
Ophidiidæ, s. fam., Günther.
Gadi, gen., Fitzinger.
Gadidæ, s. fam., Jordan & Gilbert.

Synonyms as Subfamily Names.

= *Brotulinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 188, 301, 1839.
< *Brotulina*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 371, 1862. (Defined.)
> *Brotulinæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 14], p. 280, 1863; [v. 15], p. 252. (Defined.)
> *Brosmophycinæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 14,] p. 280, 1863; [v. 15], pp. 252, 253, 1863.
> *Bythitinæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 14], p. 280, 1863; [v. 15], p. 253, 1863.
> *Sirembinæ*, Gill, Proc. Acad. Nat. Sci. Phila. [v. 14], p. 280, 1863; [v. 15], p. 253, 1863.
< *Brotulini*, Emery, Atti R. Accad. dei Lincei (3), v. 7, p. 168, 1880.
< *Brotulinæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 794, 1882.

Ophidoidea with jugular ventrals reduced to one or two rays, and the anus in the anterior half of the length.

This family is quite rich in deep-sea types, and may be divided into various subfamilies, four of which (Brotulinæ, Brosmophycinæ, Bythitinæ, and Sirembinæ) have already been indicated and defined (see synonymy). The deep-sea forms chiefly belong to the subfamily Brosmophycinæ, and perhaps one or two still undifferentiated ones whose definition is not at present possible.

BROTULOPHIDIDÆ.

Synonymy.

= *Brotulophididæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.
Ophidiidæ (*Brotulina*), gen., Günther.

Ophidioidea with subbrachial (or thoracic) ventrals reduced to simple filaments, and anus in the anterior half of the length.

The single genus *Brotulophis*, for which this family has been distinguished, is still very imperfectly known, and its affinities are doubtful.

OPHIDIIDÆ.

Family Synonyms.

< *Pantoptéres*, Duméril, Zoologie Analytique, p. 115, 1806.
< *Ofidini*, Rafinesque, Indice d'Ittiolog. Siciliana, p. 38, 1810.
< *Ophididæ*, Bonaparte, Giorn. Accad. di Scienze, v. 52 (Saggio Distrib. Metod. Animali Vertebr. a Sangue Freddo, p. 38), 1832.
< *Ophidiidæ*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 133, 1838; t. 4, p. 276, 1840.
< *Ophidonidæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 49, 259,[1] 1839.
< *Ophidiidæ*, Adams, Manual Nat. Hist., p. 105, 1854.
< *Ophidinæ*, Kaup, Cat. Apodal Fish. B. M., p. 153, 1856.
< *Ophididæ*, Rich, Encycl. Brit., 8th ed., v. 12, p. 268, 1856.
< *Ophididæ*, Girard, Expl. and Surv. for R. R. Route to Pacific Oc., v. 10, Fishes, p. 137, 1858.
< *Ophidioidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxv, 1859.
< *Ophidiidæ*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 370, 1862.
= *Ophidiidæ*, Gill, Arrangement Fam. of Fishes, p. 3, 1872.
= *Ophidiidæ*, Putnam, Proc. Boston Soc. Nat. Hist., v. 16. p. 339, 1874.
< *Ofidiidei*, Emery, Atti R. Accad. dei Lincei (3), Fis. Mem., v. 3, p. 168, 1880.
= *Ophididæ*, Jordan & Gilbert, Syn. Fishes N. Am., pp. 400, 792, 1882.

Anguilliformes, gen., Cuvier.
Xiphoides, gen., Risso, 1826.

Subfamily Synonyms.

< *Ophidiini*, Bonaparte, Nuovi Annali delle Sci. Nat., t. 2, p. 133, 1838; t. 4, p. 276, 1840.
< *Ophidinæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, p. 260, 1839.
< *Ophidiiformes*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxv, 1859.
= *Ophidiina*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 376, 1862.
= *Ofidiina*, Emery, Atti R. Accad. dei Lincei (3), v. 7, p. 168, 1873.

Ophidioidea with chin ventrals, represented by bifid barbel-like filaments, and the anus in the anterior half of the length.

This family is well-marked by the encroachment of the ventrals forwards under the chin and between the rami of the mandible, on which account the species were supposed to have barbels

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[1] At p. 49, regarded as one of the "Families of the Gymnetres; at p. 159 as the 4. subfamily "Ophidoninæ" of the "tribe Gymnetres" (family not differentiated), and at p. 259, mentioned as "3. subfam. Ophidonidæ."

analogous to those of the Mullids and to be destitute of ventrals. Their homology was not even recognized by those who studied their anatomy, Prof. Agassiz, for instance, in his Recherches sur les Poissons fossiles, representing them as apodal.

There are three or four genera, *Ophidium*, *Genypterus*, and *Leptophidium*.

Leptophidium, although recognized as a mere subgenus by Messrs. Jordan & Gilbert, is very distinct.

FIERASFERIDÆ.

Family Synonyms.

< ***Ginnotini***, Rafinesque, Indice, d'Ittiolog. Siciliani, p. 37, 1810.
= ***Fierasferidæ***, Gill, Proc. Acad. Nat. Sc. Phila., 1864, p. 203, 1864.
= ***Fierasferidæ***, Gill, Arrangement Fam. of Fishes, p. 3, 1872.
> ***Fierasferi***, Fitzinger, Sitzungsber. K. Akad. der Wissensch., v. 67, 1. Abth., p. 43, 1873.
> ***Enchelyophes***, Fitzinger, Sitzungsber. K. Akad. der Wissensch., v. 67, 1. Abth., p. 43, 1873.
= ***Fierasferidæ***, Putnam, Proc. Boston Soc. Nat. Hist., v. 16, p. 339, 1874.
= ***Fierasferidæ***, Jordan & Gilbert, Syn. Fishes N. Am., pp. 400, 791, 1882.

Ophidiidæ, gen., Bon.
Ophidioidei ophidiiformes, gen., Blkr.
Ophidiidæ, s.-fam., Günther.

Subfamily Synonyms.

= ***Fierasferina***, Günther, Cat. Fishes in Brit. Mus., v. 4, pp. 370, 381, 1862.
= ***Fierasferini***, Emery, Atti R. Accad. dei Lincei (3), v. 7, p. 168, 1873.

Ophidioidea without ventrals, and with the anus thoracic or jugular.

CONGROGADIDÆ.

Family Synonyms.

= ***Congrogadidæ***, Gill, Arrangement Families of Fishes, p. 3, 1872.
< ***Congrogadidæ***, Jordan & Gilbert, Syn. Fishes of N. Am., p. 790, 1882

Subfamily Synonyms.

< ***Congrogadinæ***, Günther, Cat. Fishes in Brit. Mus., v. 4, pp. 370, 388, 1862.
< ***Congrogadini***, Emery, Atti R. Accad. dei Lincei (3), v. 7, p. 168, 1873.

Ophidioidea without ventrals, the anus in the anterior half of the length, and branchial membranes united beneath but free from the throat.

The family is perhaps composite and has been constituted or retained for three genera (*Congrogadus* = *Machærium*, *Haliophis*, and *Scytalina*) which may prove to have little or no affinity to each other. It is entirely provisional and must remain of very uncertain value till the forms can be anatomically investigated. It is only by an assumption, perhaps, if not probably illegitimate, that *Haliophis* has been referred to the group. "Rüppell says 'Apertura branchialis parva,'" but Dr. Günther, "by a comparison of the figure" was "induced to suppose that, as in *Congrogadus*, the gill-opening is of moderate width, the gill-membranes being united below the throat, and not attached to the isthmus."[1] I should not have been induced, by the figure to make any such assumption, for the likeness to *Congrogadus* is very slight. The single specimen of *Scytalina* in the National Museum cannot be dissected.

SUPERFAMILY LYCODOIDEA.

Synonymy.

= *Lycodoidea*, Gill, Cat. Fishes E. Coast N. Am., p. 7, 1873. (Named only.)

Jugulares with the orbito-rostral portion of the cranium contracted and shorter than the posterior, the cranial cavity open in front, but bounded laterally by expansions of the annectant parasphenoid and frontals, with the supraoccipital declivous and tectiform behind, the occipitals above inclined forward along the sides of the supraoccipital, and the exoccipital condyles distant, with the hypercoracoid foraminate about its centre and the hypocoracoid with an inferior process convergent to the proscapula.[2]

These characters are formulated from a skeleton of *Zoarces anguillaris* in the possession of the writer.

LYCODIDÆ.

Family Synonyms.

× *Zoarchidæ*, Swainson, Nat. Hist. and Class. Fishes, etc., v. 2, pp. 184, 283, 1839.

> *Lycodidæ*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 319, 1862.

= *Lycodoidæ*, Gill, Proc. Acad. Nat. Sci Phila., v. 15, p. 255, 1863 (Defined); v. 16, p. 203, 1864. (Cranial characters indicated.)

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[1] Günther, Cat. Fishes in Brit. Mus., v. 4, p. 389.

[2] The nostrils are single on each side as in many Blennioidea.

= *Lycodidæ*, Gill, Arrangement Fam. of Fishes, p. 3, 1872.
> *Zoarcæ*, Fitzinger, Sitzungsber. k. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 43, 1873.
Gadidæ and Ophidini, pt., Reinhardt.
Blennioidei and Ophidoidei, pt., Bleeker.
Blennioidæ, pt., Gill, Kroyer.
Lycodidæ and Blenniidæ, gen., Günther.

Subfamily Synonyms.

> *Gymnelinæ*, Gill, Proc. Acad. Nat. Sci. Phila., v. 15, pp. 256, 261, 1863.
> *Zoarcinæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 783, 1882.
> *Lycodinæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 783, 1882.
= *Lycodidæ*, Collett, Norske Nordhavs-Exped. 1876–78; Fiske, p. 77, 1880.
= *Zoarcidæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 400, 1882.
= *Lycodidæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 783, 1882.

Lycodoidea of a more or less anguilliform shape, tapering backwards; dorsal and anal elongated and confluent with caudal, invested in a thick skin; ventrals jugular and rudimentary or suppressed, and branchial apertures lateral and not confluent.

The chief group of this family, or the subfamily Lycodinæ, is a characteristic deep-sea type, and represented by many species varying greatly in elongation, and with the extreme terms tolerably well connected by graduated representatives. Nevertheless, the two sections of *Lycodes*, defined by Prof. Collett (*op. cit.*, p. 84), seem to be entitled to generic rank, and corroborated by other species obtained by the U. S. Commission of Fish and Fisheries. The name *Lycodes* must be retained for the robust species, while *Lycenchelys* may be used as a designation for Collett's second group which have "the body elongate;" height of the body contained from twelve to twenty-four times in the total length. The genera would then be *Lycodes*, *Lycenchelys*, *Lycodopsis*, *Lycodonus*, and *Lycocara* (= *Uronectes*, Gthr.).

In the preceding diagnoses of the superfamilies Gadoidea, Ophidioidea and Lycodoidea, little more is given than what may serve to neatly differentiate the several groups, but the characters given are reinforced by many others, such as the cranial foramina, details in the relations of the bones, and characters of the vertebræ. The relations of the Brotuloidea appear to be almost as intimate, if not indeed more so, with the Lycodoidea than with the Gadoidea. But a comparison of the cranium of a Lycodid with that of a Blenniid, must convince the ichthyotomist

that there is a close affinity between the two. Indeed, it is quite possible, at least, that Prof. Cope might retain his diagnosis of the Anacanthini, and refer the Brotuloid families to his Scyphobranchii by the side of *Zoarces* and his other Blenniidæ. Prof. Emery has also perceived the great differences exhibited in cranial characters by the Ophidioidea from the Gadoidea and has even contended that they should be approximated to the Gobioidea.[1] In view of these facts, it is evident that the group of Anacanthini not only has a very uncertain tenure, but it may have either to be entirely abolished as being an unnatural combination of different types, or to be limited to the Gadoidea.

But it is possible that the group as retained by the most recent ichthyologists may be even more heterogeneous than has been supposed. Several other types have been generally associated with the forms already indicated, but the pertinence of the Ammodytidæ,[2] Ateleopodidæ and Xenocephalidæ to it is doubtful, and it is almost certain that the Gadopsidæ are not at all related to any of the families already discussed; nevertheless, to complete the summary of the families generally referred to the Anacanthini, their synonymy and characteristics are here given:—

AMMODYTIDÆ.

Family Synonyms.

= *Ammodytidæ*, Bonaparte, Catal. Metod. Pesci Europei, pp. 7, 40, 1846.
= *Ammodytidæ*, Gill, Arrangement of Families of Fishes, p. 3, 1872.
= *Ammodytæ*, Fitzinger, Sitzungsber. K. Akad. der Wissensch. (Wien), B. 67, 1. Abth., p. 43, 1873.
= *Ammodytidæ*, Jordan & Gilbert, Syn. Fishes N. Am., p. 414, 1883.

Gadidæ, s. fam., Bonaparte.
Coryphænidæ, gen., Swainson.
Ophidioidei, s. fam., Bleeker.
Ophidiidæ, s. fam., Günther.

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[1] "Attenendomi ai risultati delle mie ricerche anatomiche, io debbo, tra le due opinioni, adottare quella del Canestrini e considerare gli Ofidiidei come affini di Gobioidi, coi quali hanno caratteri comuni assai importanti, in ispecie nella struttura del cranio." Emery, *op. cit.*, p. 169; see also p. 187.

[2] The only skeleton at present accessible to me, has been so badly prepared that I do not venture to base any opinion upon it. I hope soon to have a clean disarticulated one.

Subfamily Synonyms.

= *Ammodytini*, Bonaparte, Nuovi Annali delle Sci. Nat., p. 133, 1838; t. 4, p. 276, 1840.
= *Ammodyteiformes*, Bleeker, Enum. Sp. Piscium Archipel, Indico, p. xxv, 1859.
= *Ammodytina*, Günther, Cat. Fishes Brit. Mus., v. 4, p. 384, 1862:
= *Ammodytinæ*, Gill, Cat. Fishes E, Coast N. A., p. 40, 1861.
> *Argyrotæninæ*, Gill, Cat. Fishes E. Coast N. A., p. 40, 1861.

Anacanthini? with an elongated, almost parallelogrammic body, with a dorsal lateral line, postmedian anus, narrow suborbitals, terminal mouth with protractile jaws, enlarged suboperculum, widely cleft branchial apertures, lamelliform pseudobranchiæ, a long dorsal and long but postmedian anal with articulated rays, low pectorals and no ventrals.

ATELEOPODIDÆ.

Synonyms as Family Names.

= *Ateleopodoidei*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxvi, 1859. (Not defined; made the type of a distinct order—"Ateleopodi—au forte cum Siluris adjungendi.")
= *Ateleopodidæ*, Günther, Cat. Fishes Brit. Mus., v. 4, pp. 318, 398, 1862.
= *Ateleopodidæ*, Gill, Arrangement Families of Fishes, p. 3, 1872.

Synonym as Subfamily Name.

= *Ateleopodini*, Bonaparte, 1850.

Anacanthini? with an elongated tail tapering backwards, but provided with a narow caudal, antemedian anus, moderate suborbitals, inferior mouth, thoracic ventrals reduced to double or simple filaments, a short anterior dorsal only, and a long oval continuous with the caudal.

XENOCEPHALIDÆ.

Synonyms.

= *Xenocephaliformes*, Bleeker, Enum. Sp. Piscium Archipel. Indico, p. xxvi, 1859.
= Appendix to the Anacanthini Gadoidei, Günther, Cat. Fishes in Brit. Mus., v. 4, pp. 318, 399, 1862.
Gadoidei, s. fam., Bleeker.

Anacanthini? with a "small body," a distinct caudal, postmedian anus; head very large, truncated, cuirassed with plates

and armed with spines; jugular? ventrals of five rays and one short dorsal, and a short anal, both near the caudal.

Two other types referred by Dr. Günther to the Anacanthini certainly do not belong to the group and are true Acanthopterygian fishes. They are the Gadopsidæ and Chiasmodontidæ.

GADOPSIDÆ.

Synonymy.

= ***Gadopsidæ***, Günther, Cat. Fishes Brit. Mus., v. 4, pp. 317, 318, 1862.
< ***Gadopsidæ***, Cope, Proc. Am. Philos. Soc. Phila., v. 13, p. 31, 1873.
-***Blenniidæ***, gen., Steindachner.

CHIASMODONTIDÆ.

Family Synonyms.

= ***Chiasmodontidæ***, Gill, Jordan & Gilbert, Syn. Fishes N. Am., p. 964 1882. (Defined.)
Gadidæ, gen., Günther.

Subfamily Synonym.

= ***Chiasmodontinæ***, Jordan & Gilbert, Syn. Fishes N Am., p. 795, 1882.

JUNE 24.

Dr. W. S. W. RUSCHENBERGER in the chair.

Fifteen persons present.

A paper entitled "Notes on the Geology and Natural History of the West Coast of Florida," by Jos. Willcox, was presented for publication.

Some Modifications observed in the Form of Sponge Spicules.—Mr. EDW. POTTS remarked that whatever view we may prefer to take as to the position which sponges occupy in the animal kingdom —whether they are regarded as colonial flagellate monads with Saville Kent, or with Haekel take a much higher place among the metazoa, or perhaps, with still greater probability, fill an intermediate place between these, the formation and development of the spiculæ in both the Calcarea and Silicea seem likely to remain for a long time one of the most perplexing problems. Many terms of this conundrum will readily occur to the mind of any one who has worked in this field and observed the spiculæ from their earliest appearance to full maturity, and it is not the design of the present communication to refer to them now more particularly.

An instance, however, in which a singular modification of character has apparently been effected by the chemical condition of the environment seems deserving of mention. Amongst the sponges to which he had alluded in former communications as encrusting certain old pipes, recently removed from the waterworks on the Schuylkill River, in Philadelphia, some portions were much more deeply colored with rust than the others; the statoblasts, particularly, seeming to be mere pseudomorphs of their originals in iron oxide. Fragments of this character were boiled in nitric acid, washed out and mounted for comparison with other matter similarly treated, but free from such discoloration.

The mature normal skeleton spicule of this sponge, *Meyenia Leidyi*, is smooth, robust and shorter than that of any other American species. Very rarely the fine line of the axial channel is visible, but in the specimen under examination the size and exterior appearance of the spiculæ remaining as before, the hardly noticeable channel has become a wide canal, open at both ends, and occupying more than one-half the breadth of the spicule. This does not occur merely in occasional instances, but universally throughout the fragment of sponge so affected. (See fig. 5, Plate IV.)

The birotulate spicules of this sponge also are short and of a

peculiarly substantial appearance, with entire reflexed margins, yet in the present preparation they could with difficulty be detected as mere ghosts of their normal shapes. The two discs rarely remained together, their characteristic entire margins were gone, the rotules being represented merely by a line of very fine rays. The speaker ventured no suggestion as to the influences or the method by which these changes had been effected, but referred the fact to the consideration of students more competent to deal with the mechanical and chemical constitution of these bodies.

Lieut. Thos. L. Casey, Eng. Corps, U. S. A., was elected a member.

JULY 1.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Thirteen persons present.

A paper entitled "On a supposed new species of Cristatella," by Edw. Potts, was presented for publication.

Volcanic Dust from Krakatoa.— Prof. H. CARVILL LEWIS remarked that in connection with the cause of the beautiful red sunsets of last autumn and winter, which had been recently the subject of much discussion in the scientific periodicals, he had been interested in examining some volcanic dust which had been ejected from the volcano of Krakatoa, and which he had received through the kindness of Rev. Wayland Hoyt, D. D., of this city.

This dust, which, on August 27, 1883, fell thickly upon the decks, rigging and masts of the bark William H. Besse, bound from Batavia to Boston, is of a light gray color and harsh to the touch. It is essentially a pulverized pumice, by far the greater part of it consisting of fragments of volcanic glass. These fragments are sometimes twisted, but generally in flat angular transparent scales, which are filled with minute bubbles, and, of course, are isotropic. Angular fragments and crystals of transparent plagioclase, occasionally showing the hemitropic striations, and giving bright colors in the polariscope, together with more irregular and rounded fragments of dark green and brown pyroxenic minerals, probably augite and hypersthene, are scattered very occasionally among the glass particles. Grains of magnetite, often well rounded, also occur, and may be picked out and examined separately by a magnet covered with tissue-paper.

As it is this dust which is regarded as the cause of the universal red skies which followed so soon after the eruption, attempts have been made, both in Europe and America, to discover traces of it in snow or elsewhere.

In the suburbs of Philadelphia, some dust was collected by Mr. Joseph Wharton,[1] this winter, from melted snow, and from the presence in it of certain rounded and filamentous glass particles supposed by him to be volcanic. Some of it had been submitted by him to the speaker for examination. It appeared to be composed of particles of quartz, coal, cinders, vegetable matter, etc., among which are certain glassy hairs and rounded globules. These bear no resemblance to the angular glass fragments composing the Krakatoa dust, which is remarkably free from either filaments or globules; and the supposed volcanic glass particles in the Philadelphia dust are most probably of local origin—from blast-furnaces, foundries, or the like.

Accompanying the specimens of dust from Krakatoa, were extracts from the log of the bark, which present several points of interest. A point of special importance is the record of a sudden barometric fluctuation, due to a great atmospheric wave, which, starting from the volcano at the time of the eruption, has been shown to have "traveled no less than three and a quarter times round the whole circumference of the earth."[2]

Extracts from log of bark William H. Besse, from Batavia towards Boston.

"*Aug. 26.* This day commences with light airs and calms. Light airs throughout the day. At 5.30 P. M., wind hauling ahead, let go starboard anchor with thirty fathoms chain, clewed up and furled all sail. Adam light bore W. 1-4 S. and E. by S. Throughout the afternoon and night heard heavy reports, like the discharge of heavy artillery, sounding in the direction of Java Island. Very dark and cloudy throughout the night, with continual flashes of lightning. Barometer 30.15.

"*Aug. 27.* Commences with strong breezes, and thick, cloudy weather. Barometer 30.12. At 9.30 A. M., pilot left ship. Hove the lead every fifteen minutes. At daylight noticed a heavy bank to the westward which continued to rise; and, the sun becoming obscured, it commenced to grow dark. The barometer fell suddenly to 29.50, and suddenly rose to 30.60. Called all hands, furled everything securely, and let go the port anchor with all the chain in the locker. By this time the squall struck us with terrific force, and we let go starboard anchor with eighty fathoms chain. With the squall came a heavy shower of sand and ashes, and it had become by this time darker than the darkest night. *The barometer continued to rise and fall an inch at a time.* The wind was blowing a hurricane, but the water kept very smooth. A heavy rumbling, with reports like thunder, was heard continually; and the sky was lit up with fork lightning running in all directions, while a strong smell of sulphur pervaded the air,

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[1] See his letter in *Public Ledger*, Jan. 22, 1884.

[2] *Nature*, vol. xxx, p. 12.

making it difficult to breathe. Altogether, it formed one of the wildest and most awful scenes imaginable.

The tide was setting strong to the westward throughout the gale, at the rate of ten knots per hour. At 3 P. M. the sky commenced to grow lighter, although the ashes continued to fall. The barometer rose to 30.30, and dropped gradually to 30.14, when it became stationary. The whole ship, rigging and masts, were *covered with sand and ashes to the depth of several inches.*

"*Aug. 28.* Commences with light airs and thick, smoky weather. Hove up starboard anchor, and hove short on port anchor. Dead calm throughout the day and night. Saw large quantities of trees and dead fishes floating by with the tide; the water having a whitish appearance, and covered with ashes. This day ends with a dead calm, and thick, smoky weather.

"*Aug. 29.* This day commences with calms, and thick, smoky weather. Made all sail throughout the day. Moderate winds, and thick, smoky weather. Passed large quantities of driftwood, cocoanuts, and dead fishes. At 8 P. M., passed Anjier, and could see no light in the lighthouse, and no signs of life on shore. Furled all light sails, and stood under easy sail throughout the night. Day ends with moderate winds and cloudy weather. Barometer 30.14.

"*Aug. 30.* Commences with moderate winds and cloudy weather. At daylight made all sail with a fresh breeze from the westward. Found the water for miles filled with large trees and driftwood, it being almost impossible to steer clear of them. Also passed large numbers of dead bodies and fish. Kept a sharp lookout on the forecastle throughout the day. At 10 A. M., sighted Java Head lighthouse; but the wind hauling ahead, we kept away, and went round Prince Island. Latter part, fresh breezes and *thick, smoky weather.* Friday and Saturday, passed large quantities of ashes in the water. Saturday, crew employed in cleaning ashes off masts and rigging. Water had a green color."

JULY 8.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Eleven persons present.

A paper entitled "Catalogue of Sponges collected by Mr. Jos. Willcox on the West Coast of Florida," by Henry J. Carter, was presented for publication.

The following were ordered to be printed :—

NOTES ON THE GEOLOGY AND NATURAL HISTORY OF THE WEST COAST OF FLORIDA.

BY JOSEPH WILLCOX.

The following notes apply especially to the Counties of Levy and Hernando in Florida. That portion of the Peninsula consists of a fine grained limestone composed largely of foraminifera, several species of which have been determined by Prof. Heilprin. The limestone is covered with sand, in some places with a thin layer only, while, at other localities, wells sunk to the depth of 25 or 30 feet have failed to indicate the presence of rocks. In many places the rocks are exposed above the surface of the ground. They are hard and compact when dry; but, when they are permanently wet, they are comparatively soft, and are eroded with facility. In fact, throughout a large portion of the State numerous and long subterranean caverns abound, that serve as aqueducts to convey the water supplying the many large springs, for which this territory is noted.

The subsidence of the surface ground into these caverns has caused many sink-holes. Three miles south of Gainesville, within a space of less than 100 acres, nearly fifty funnel-shaped sink-holes exist, from 20 to 200 feet in diameter at the top, and from 10 to 50 feet deep.

These are near to Payne's Prairie, a lake covering a space of about forty square miles. This lake has no outlet, and its surface rises and falls, as is usual in such cases, according to the abundance or scarcity of rain.

It covers an area that was dry land a few years ago. The creek, which now supplies water to it, formerly flowed into a sink hole near those mentioned above. This creek undoubtedly was the active agent in eroding the caverns into which the material formerly occupying the space where the sink-holes now exist was precipitated. Some sink-holes are large and the subsidence moderate. Examples of the latter case may be seen in numerous shallow ponds and cypress swamps. Many large lakes probably owe their existence to the same cause.

The limestone is, in some localities, replaced by a chert rock, in which the casts of shells are still visible. This rock forms the

only material suitable for the manufacture of stone implements, that the writer has seen in Florida.

The coast is fringed with a strip of land four to six miles wide that is low, level and rocky, from Cedar Keys to Anclote Key, seventy-five miles farther south.

A large portion of this land is swampy; and much of it is covered with water, when the tide is unusually high; while the highest portion of it is only 3 or 4 feet above the level of high water.

It is covered with a shallow, rich soil, which sustains a dense growth of hard wood, in addition to many palmetto and red cedar trees.

At a distance of from eight to twelve miles apart small rivers empty into the Gulf. They have their sources chiefly in large springs, which are supplied by long, subterranean caverns. They have cut crooked channels through the limestone rocks, not only on the mainland, but through the shoals to the deep water of the Gulf.

These rocks, the foundation of the mainland, extend westward under the water of the Gulf of Mexico; and for the distance of several miles from the shore great shoals exist; making navigation impracticable, except for small vessels. At low tide the rocks are exposed to view in numerous instances, far from shore. In fact such a great number of low islands exist along the coast, separated from each other by shallow bays and creeks, that it is difficult to determine what should be classed as the shore line.

Many of these islands are overflown with water at high tide. In such cases they are covered with mud: those nearest to the sea usually sustaining a dense growth of mangrove trees; while others nearer the mainland are covered with saw-grass and bull-rushes.

A soft and unctious mud covers the bottom to the depth of a few inches in the shoal water; and an abundance of sea weeds thrives there. These afford shelter to vast numbers of mollusks, crustaceans and worms, to the life of which those waters are well adapted.

The coast undoubtedly extended much farther into the Gulf, at a time not very remote. On the bottom of the shoals and rivers, and along the shores, the limestone rocks are eroded in a very rough and uneven manner. No smooth surfaces are to be seen:

nothing but sharp, unsightly projections, depressions and deep holes. Along the rivers the waves make many small caverns under the shore.

East of the narrow, rocky belt, lining the shore, the land is sandy and rises to the height of about 200 feet at a distance of from twelve to twenty miles from the coast. The highest land near the coast is at Mount Lee, in Hernando Co., twelve miles from the Gulf, and four miles east of the source of the Homosassa River.

The summit of this hill is 200 feet above the sea, and it terminates abruptly, on the west side, in a rocky bluff 100 feet high. From the top an extensive view may be obtained of the surrounding country, an opportunity seldom afforded in middle and southern Florida. Under this hill are several caverns which have not been opened for exploration; but the noise from falling stones indicates a considerable depth in them. A rib of a manatee has lately been dug from the soil in a small cave in the side of the hill. The limestone at this place is hard and fine grained; and if found to be free from fissures, it will prove to be a desirable building stone. The surface of this rock is rugged and unsightly; having been eroded in the usual, uneven manner.

About five miles northeast of Mount Lee the writer discovered a second locality of *Nummulites Willcoxi*, at an altitude of nearly 200 feet above the sea. They are associated with *Orbitoides* and *Heterostegina* and *Pecten*, as determined by Prof. Heilprin.

The shore of the Gulf of Mexico abounds with multitudes of shells of king-crabs, suggestive of a great mortality among them. At low tide the writer found one king-crab lying upon its back with *Fasciolaria tulipa* on top of it, eating its vitals. Near by was found another lying on its back, upon which were 25 mollusks (*Melongena corona*) eating it.

In Clearwater Harbor, north of Tampa Bay, the sea-urchins, during the first week in April, are covered with shells arranged upon them with system and dexterity, so that they are obscured from view.

Prof. Leidy, when informed of this habit, suggested that it might have some connection with the process of spawning. This suggestion is plausible, as in the same waters in January, though abundant, none of them were found to be covered with any material. Prof. A. Agassiz[1] states that "the sea-urchins, in

[1] See Seaside Studies in Nat. History, page 101.

Boston Harbor, have a habit of covering themselves with seaweeds, packing it down snugly above them, as if to avoid observation: and this habit makes them difficult to find." In Clearwater Harbor the white shells, with which the sea-urchins cover themselves, make a conspicuous object, so that the animal underneath can easily be found. They evidently do not seek concealment from an enemy, as the seaweeds would more effectually accomplish that object.

The shell mounds of the west coast are very numerous; and they indicate the former favorite camping grounds of the Indians.

The largest accumulation of shells is at Cedar Keys. A portion of that town is built upon the mound; and great quantities of the material, consisting almost exclusively of oyster shells, have been used in grading the streets.

Oysters are very abundant and of good size in the vicinity of Cedar Keys, and along the coast as far as forty-five miles farther south. The following small rivers flow into the Gulf of Mexico near the oyster beds:—Wakasassa, Withlacooche, Crystal River, Little Homosassa, Homosassa and Cheeshowiska.

Near the outlets of these rivers are numerous small islands, too low to be habitable, except when elevated by artificial means. At each river the Indians selected an island for their camping ground, to which they carried oysters; the shells, in the course of a long time, making large mounds. Human bones, stone implements and fragments of pottery are frequently found among the shells.

Prof. Wyman, having examined many fresh-water shell mounds, on and near the St. John's River, states in the Memoirs of the Peabody Academy of Science, vol. i, No. 4, 1875, on page 49, that "Stone chips are not common, and were generally found separately, or only a few together; but in no instance in collections indicating a place for the manufacture of arrow heads or other implements." Such a place for the manufacture of stone implements may be seen on John's Island at the mouth of the Cheeshowiska River. Having visited this island mound several times, the writer has found there at least a half bushel of stone implements, in the various stages of manufacture; and at the present time many bushels of the stone chips may be seen there, all made of the chert rock referred to above.

On this island may also be found shell implements of several patterns, made from the shells of *Busycon pyrum.*

The stone implements found there are similar to those figured on Plate II, in the Memoir referred to, and the shell implements are similar to those on Plate VII of the same. Near Dwight's Landing, on the shore of Clearwater Harbor, is an Indian mound composed chiefly of the shells of *Busycon pyrum* and *Fasciolaria tulipa;* the former greatly predominating in numbers. Nearly all of these shells have a hole in the side near the top, about three-quarters of an inch in diameter, all neatly and uniformly made.

It is presumed that the animal was detached from the shell by the Indians, by means of an instrument inserted through this hole.

ON A SUPPOSED NEW SP CIES OF CRISTATELLA.

BY EDW. POTTS.

I wish to announce the discovery in October last, within the waters of Harvey's Lake, Luzerne Co., Pa., of vast colonies, or, technically speaking, of aggregations of colonies of a species of *Cristatella*, exhibiting some peculiarities that seem to distinguish it from *C. mucedo* of Europe and from both the known American forms.

Harvey's Lake is a beautiful sheet of water, lying at an altitude of about 1200 feet above sea-level, amongst partially wooded hills of no great height, and taking rudely the shape of the capital letter T. Its greatest length is about two miles. The depth throughout the larger part of this extent is said to be very great, increasing rapidly a few feet from the shore. The first groups of this beautiful polyp were found upon a large inclined log or stump in deep water, within one or two feet of the surface. Here the colonies appeared as scattered vermiform masses much longer than those of *C. Idæ* of Leidy, and nearly rivaling in length those of *C. ophidioidia* of Hyatt. The longest were estimated at about six inches. Instead, however of following the sinuous lines, described by the latter author as characteristic of his species, these assumed, generally, single or continuous curves, like a parted letter O or rude C. Afterwards, in three or four instances, we found them occupying entirely novel situations.

The tops of fallen trees or large branches lying 20 or 30 feet from the shore, and spreading to a diameter of 10 or 12 feet, were covered by hundreds or thousands of these colonies, clinging to or twining around every branch and twig, yet with so slight an attachment that the motion of raising a twig above water caused them to drop off by dozens. While hanging temporarily by one end they assumed a spiral form, closely twisting upon themselves. Their gelatinous common ectocyst, nearly a line in thickness, lined the branches as far as we could reach or see. Its persistence upon those twigs brought away with us is rather remarkable, as after remaining seven months in water it is still easily recognizable. It exhibits under the microscope a plexus of fine lines like a very delicate mycelium, which indeed may now have replaced the normal structure.

The pocket lens of the collector was of course insufficient to reveal any distinctive characters in the individuals composing these colonies, and we failed in the attempt to bring any of them alive within reach of our microscopes, so that a full determination of the species has awaited the recent germination of some of the numerous statoblasts then secured. Their death in the glass jar, in which some of the colonies were carried, made it necessary several times during the past winter to change the water and wash out the corrupt matter. On these occasions the statoblasts were saved by pouring the water through a sieve. The winter months passed, and April and May came, but still they did not germinate, and I was on the point of discarding the whole as lifeless when a number of embryo colonies were fortunately discovered upon the sides of the jar.

These consisted of from one to eight polypides and exhibited this constant peculiarity. The cœnœcium, in a lateral view, might be compared in shape to a shoe; the cœnœcial cells, whether few or many, occupying solely the elevated or ankle portion; the other extremity was always prolonged into one of the many forms which fashion has dictated for our foot-covering, from the cylindrical pointed toes of some hundrds of years ago to the abbreviated stumps which still form the Chinese ideal of beauty. This feature was very conspicuous, but as I am unable to compare these young colonies with other species at a similar stage, I hesitate to assume its novelty. In the later hatchings it is far less noticeable, and in the most advanced stages which any of the healthy colonies have reached, the prolongation has ceased to be a prominent feature.

An ounce phial contained a quantity of the statoblasts which were supposed to have lost their vitality by "fouling." These were now washed thoroughly in a sieve and placed in a half-gallon jar of water. In about ten days I was rewarded by finding that they had germinated by scores, and the surface of the water was dotted with tiny groups floating with the disc side upward; the polyp heads and their beautiful plumes of tentacles depending and spreading below.

On removing a number of the statoblasts, firmly held together by their marginal hooks, for more minute examination under the microscope, I found them in all the primary stages of development; from the as yet unaltered condition in which whatever of

life may have quickened their long dormant cells, was hidden from sight by the opaque chitin of their valves, to that in which these had been pushed off to right and left and the neophite had reached forth to discover the nature and limitation of the new scene into which he had entered.

The statoblasts, as in the other species of this genus, are orbicular, reddish brown in color, relatively thick, with rounded marginal annulus and a double series of retentive hooks. The latter spring from circular membranous lines on each side, near the circumference of the chitinous body, and on one side are reflexed from the margin, while those pertaining to the other curve abruptly, partly around the annulus and then become radial in the equatorial plane; their surfaces are roughened or minutely tuberculated. Little difference is noticeable between the diameters or the degrees of convexity of the exposed sides of the statoblast; that, however, to which the longer bent hooklets are attached, is generally the larger, with a single sweeping curve, while the other has often a higher convexity at its centre. The chiton is composed of minute hexagonal cells whose outer surfaces appear to be concave[1] or depressed, but their margins are elevated here and there at the angles, into spinous papillæ, with rounded apices, more numerous near the circumference of the statoblast.

As the germination of the enclosed embryo progresses the sides or valves are forced apart, separating always at the same portion of the margin; the whole annulus remaining attached as before described, while the chitinous rim of the other is drawn out from under it, as a pill-box is separated from its lid. This is in marked contrast with the process by which the valves of *Pectinatella* are separated, as shown in the accompanying diagram.

The rounded edge of the semitransparent cœnœcium now appears and slowly protrudes itself so that it is some hours before the first polypide projects his immature tentacles. In the beginning, and sometimes for several days, the cœnœcium is nearly filled with granular particles of yolk-like matter, opaque by transmitted light and of a light waxen yellow[2] when reflected light is

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[1] Prof. Allman describes the chiton cells of *C. macedo* as *convex* upon their outer surface which thus become "elegantly mammillated." A transverse section of the statoblast shows that the annulus is firmly attached to that side on which the hooks are reflexed, and spreads broadly over the rim or margin pertaining to the opposite valve.

[2] These are white in Pectinatella.

used. These are frequently collected into spherical groups, and one or more may occasionally be seen in the act of circulation or of violent revolution—the result probably of ciliary currents within the cœnœcium. These granular masses adhere to the stomach and other internal organs, obscuring their outlines and making it nearly impossible to detect the appearance of the secondary polypides; they follow, however, so soon after the first, that it is believed that several heads are considerably advanced before the separation of the valves of the statoblasts. The tentacles of the first polypide, however, are generally much better developed when it appears, than are those of the succeeding forms, indicating a nearer approach to maturity. The effect of ciliary action is quite evident in this immature condition, but the cilia themselves are minute and difficult of definition. The granular bodies and groups which obscured the body of the cœnœcium become gradually absorbed, or in some way eliminated, remaining latest in the caudal projection and finally entirely disappearing.

The whole cœnœcium then becomes beautifully transparent, disclosing not merely the structure of the individual polypides even when retracted, but the fine lines of the numerous retractor muscles may be readily traced from their connection with the stomach branchia, to their insertion in the disc or opposite portion of the endocyst. The fact that the insertion of these muscles occur in nearly parallel or radial lines upon the disc of the cœnœcium may account for the term used by writers who speak of the *cells* of the cœnœcium; but there are no cell walls, and, when entirely retracted, the stomachs of the individual polypides pass through the lines of muscular filaments and lie wherever they can find room. This "finding room" for their several personalities is often a matter of considerable difficulty to them, and of no little amusement to the observer, who, when a colony is disturbed will see the first few polypides retire with some appearance of graceful ease, but the laggards must struggle to tuck themselves into a bed where six or eight are already lying, and repeated jerks and jostles are necessary before they can finally hide themselves, as they seem to think, by drawing the transparent coverlid of the endocyst together over their heads.

The cells of the outer layer of the endocyst are in this genus larger and of greater depth than the corresponding series in *Pectinatella;* and in both genera appear to be of the same char-

acter over the whole surface of the cœnœcium, there being no such arrangement of locomotory apparatus upon the lower surface in *Cristatella* as Prof. Allman describes and figures in the case of *C. mucedo.*[1] In both genera, also, by a delicate manipulation of the light under a high power of the microscope may be detected the fine lines of transverse and longitudinal muscular tissue which form the third and fourth layers of Prof. Hyatt's series, and are visible also under the thinner cell structure of the evaginated polypide.

As generally accepted, the ectocyst, which, in *Pectinatella*, forms a solid and constantly thickening mass of gelatinoid matter, is in this genus thrown off as a fugitive film, or, more generally, a pavement layer of effete matter that supports the colonies and upon which their locomotion is effected. When the young colonies have been liberated from the floating statoblasts in my jars, they float, as has been already described, with their discs at the surface of the water, and this delicate, invisible film spreads upon the surface, uniting the neighboring colonies and forming a common basis of support from which they do not appear voluntarily to remove. In a natural situation on a stream or pond the wind or currents would probably soon waft them against some solid substance which they would afterwards colonize and inhabit. As has been said, no especial contrivance appears to exist for facilitating the locomotion of these colonies, and, while their power in this respect is, of course, unquestionable, the writer is inclined to doubt whether it is exercised voluntarily and with a purpose, or is not rather an accidental result of the frequent contractions and expansions of the retractor muscles disturbing the position of alternate portions of the disc. This seems the more plausible, as we do not find in this species any method of prehension in the colonies, but merely a gelatinous or slimy cohesion to the ectocyst.

At maturity the evagination of the polypide in the species under consideration is complete, leaving not only no "invaginated fold" but exhibiting the whole digestive system of the polyp

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[1] "In the middle of the flattened under surface is an oval disc resembling the foot of a gasteropodous mollusk. On this disc, which is contractile and admits of frequent changes of shape, the colony adheres to neighboring objects or creeps about on submerged leaves and stems of aquatic plants, etc."

some distance beyond the surface of the cœnœcium. The total length of the digestive tract is rather less than that of the lophophoric arms and about equal to that of the outer rows of tentacles. These are fewer in number than in any other described species, ranging from 52–60.[1] In the great majority of the polyp heads which have been examined the number was 54; far less frequently they range upward through 56 and 58 to 60, in only one instance passing that number. On the other hand the tentacular hooks of the statoblasts are more numerous than in *C. ophidioidea*, and about the same as in the other species.

Three species of the genus have been already described, *C. mucedo*, Cuvier, in Europe, and *C. Idæ*, Leidy, and *C. ophidioidea*, Hyatt, in America. The differences existing amongst them are not considerable, and it admits of question whether all should not be merged under the prior title. In the present condition of the subject it would seem that the species now brought forward is at least as clearly differentiated from any of the former ones as they are from each other. I will therefore name it, provisionally, *Cristatella lacustris*.

EXPLANATION OF PLATE IV.

FIG 1 represents a transverse section through the centre of a statoblast of this species, *Cristatella lacustris*; *a*, *a*, the exposed chitinous surfaces of the valves; *b*, *b*, the reflexed; *c*, *c*, the bent, incurved retentive hooks; *d*, *d*, section of the annulus, or ring of air cells surrounding the chitinous body of the statoblast; *e*, *e*, the part of the rim at which the valves separate at the time of germination, as is shown on a larger scale in

FIG. 2, which represents one end of the section of a similar statoblast in the act of separation, the parts indicated by letters corresponding to those on fig. 1, with the addition of *f*, a delicate film which is being stripped from the under surface of the annulus, and *g*, *g*, which suggest the relative sizes and frequency of the papillæ upon the exposed surface of the valves.

FIG. 3 exhibits for comparison a corresponding section of the statoblast of *Pectinatella magnifica*, Leidy, lettered as before; *a*, *a*, the exposed surface of the valves; *b*, *b*, the single series of anchorate hooks; *d*, *d*, sections of the annulus, itself divided by the line *e*, *e*, along

[1] In *C. mucedo* and *C. Idæ* these are said to be "about 80." In *C. ophidioidea*, "not above 90."

which the separation of the valves in this genus is effected, as shown in

FIG. 4, much the larger portion of the annulus with all the hooks (which are formed by expansions of its dermal surface) remaining upon one side, and a smaller part, composed of coarser air cells upon the other. It will be noticed that in *Pectinatella* the annulus is formed of two distinct series of cylindrical cells, short upon one side of the separating line, several times this length upon the other. The corresponding cells of *Cristatella* are much more complicated, being formed about numerous transverse lines upon the internal surface. The figures have been carefully drawn by the aid of the camera lucida.

FIG. 5. Outline views of the skeleton and statoblast spicules of the sponge *Meyenia Leidyi*: *A*, the normal skeleton spicule; *B* and *C*, side and end views of the normal birotulate; *a*, *b*, *c*, the corresponding features as modified by their environment upon the iron pipes as described.

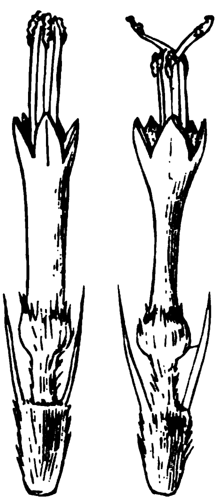
JULY 15.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Fifteen persons present.

A paper entitled " The Geology of Delaware," by F. D. Chester, was presented for publication.

On Elasticity in the Filaments of Helianthus.—Mr. THOMAS MEEHAN remarked that in many composite flowers the pollen is ejected from the apex of the staminal tube, and it became a matter of interest to ascertain the mechanism by which this is accomplished. The flowers of compositæ are much frequented by pollen-collecting insects. Honey-gatherers seldom resort to them. It is difficult on this account to watch the flow of pollen in the open air, as it is collected by the insects as fast as it appears. Some flowers of *Helianthus lenticularis*, Dougl., were gathered, and for the purpose of study placed in saucers of water in a room where insects could not disturb them. In this way it was observed that after the corolla tube had reached its full length, very early the following morning the staminal tube commenced to grow beyond the mouth of the corolla, and by about 9 A. M. had extended to a distance of about one-fourth the whole length of the corolla. The pollen then commences to emerge through the upper portion of the staminal tube, which, the stamens narrowing, has the apices free. During the day the pollen continues to pour out, till by nightfall a large amount has accumulated at the apex of the tube. A floret at this stage of growth is represented by fig. 1. The morning of the second day the arms of the pistil emerge and commence to expand, and at once the staminal tube begins to descend, exhibiting at the end of the second day the appearance indicated by fig. 2. By the end of the third day, the staminal tube has retired entirely within the tube of the corolla, and with the pistil, commences to wither. A careful examination shows that through the whole course the column of united anthers remains entirely of the same length. It is the filaments only which are elastic. These stretch fully one-half their length. They are attached to the tube of the corolla at the inflated portion a short distance above the achene, and extend to about midway between this point and the end of the tubular portion at the base of the limb; but when the anther tube is extended as described in fig. 1, the filaments occupy the



1. 2.

whole of this space. This pollen could fall on the stigma of the flower of the previous day, but as the stigma is already covered by pollen of its own, other pollen is hardly likely to be of much service; and even if this outer circle did profit by the pollen of the inner, it would not be cross-fertilization in any legitimate sense of the word. We may say emphatically that the arrangements favor self-fertilization.

An interesting feature is the change in the form of the floret on the second day of expansion. At the point where the stamens are inserted on the corolla, the tube is somewhat inflated and covered by short hair. On the first day this inflated portion is elongated, and the whole tube uniformly cylindrical, as in fig. 1. On the second day the inflation is depressed, and the corolla hypocrateriform as in fig. 2. This is probably owing to the partial withering of the corolla, but it is worth noting as a guide in the study of the florets of compositæ—the normal form is that exhibited before the anthers mature.

The extension of the staminal tube is evidently mechanical, and is due solely to the upward growth of the stigma, which, partly it seems by the incurved points of the stamens, and partly perhaps by the expansion of the arms of the pistil, is able to carry the tube up with it. This force being removed as soon as the arms emerge, the elastic stamens draw the tube down again to its normal location. This portion of the observation was made by Mr. Alois Lunzer, the artist of the *Flowers and Ferns of the United States*, then engaged in making a painting of the flower for that work.

The effect of this process is to render the plant strictly a self-fertilizer. The arms of the pistil are covered with rigid hair having an upward direction. By the pushing upwards of the pistil in its endeavor to escape from the embrace of the stamens, these hairs brush the pollen upwards, and it is in this way that the pollen is forced through the fissures at the apex as already described. When the arms emerge, they are completely covered with own-pollen, which remains till the stigmas mature.

Helianthus lenticularis is the common annual sunflower of the Western plains, and believed by Professor Asa Gray to be the parent of the garden sunflower. This is not in bloom at the present date. One species, *Helianthus hirsutus*, is in bloom, and exhibits similar features, and they are probably characteristic of the whole genus, and perhaps of other composite plants. In *Centaurea* the apex of the anther tube is closely united, and is taken up with the development of the pistil, which finally escapes through a rupture at the side. But in this case there seems to be a cotemporaneous growth of the filaments. At any rate there is no elasticity, and the staminal tube is not drawn back to the tube of the corolla. Pollen is, however, brushed out by the stigmatic hair, and each floret receives own-pollen as in *Helianthus*.

The following was ordered to be printed:—

CATALOGUE OF MARINE SPONGES, COLLECTED BY MR. JOS. WILLCOX, ON THE WEST COAST OF FLORIDA.

BY HENRY J. CARTER, F. R. S., ETC.

The fragments of the sponges collected by Mr. Willcox which reached me from Philadelphia on June 12, 1884, are all numbered, 1–59, and have been taken from specimens which, bearing the same numbers, have been retained at Philadelphia for identification, when the result of my examination shall have been received; hence the numbers in the catalogue will be found to correspond with those on the specimens at Philadelphia.

It should be remembered that they are all *dry* specimens, and that what I have to examine are *only* "fragments," hence there is very little to be said of each beyond name, form, consistence and color, together with the form and dimension of the spicule respectively, while they are arranged in accordance with the classification that I have proposed in my "Notes Introductory to the Study and Classification of the Spongida," published in the Annals and Magazine of Natural History, for 1875, vol xvi, p. 1, etc.[1]

Catalogue.

Ord. II. CERATINA.

Fam. 2. APLYSINIDA.

No. 19. *Aplysina cauliformis*, Crtr. ("Annals and Mag. Nat. History," 1882, vol. ix, p. 270).

Ord. III. PSAMMONEMATA.

Fam. 1. BIBULIDA.

Group 2. Paraspongiosa.

No. 41. *Paraspongia* ?——sp. Allied to the officinal sponge, but with more arenaceous (sand-bearing) fibre.

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[1] Abbreviations.—"Ann." for Annals and Mag. of Nat. Hist.
"Bk." for Bowerbank, monograph of British Spongiada, vol. iii.
"Sdt." for Schmidt.

Measurements of the spicules those of the *largest present*, showing their dimensions across and longitudinally.

FAM. 2. HIRCINIDA.

Group 3. HIRCINIOSA.

No. 23. *Hircinia ?* —— sp. Massive, erect, lobate. Surface even, minutely reticulated; projecting arenaceous tags; consistence resilient. Color now brown.

No. 26. *Hircinia ?* —— sp. Fragment too insignificant for description.

No. 31. *Hircinia tubulosa*, Crtr. Consisting of a conical mass of erect tubular processes. Consistence resilient. Color light sponge. Fibre scantily cored with arenaceous substance (named after its form).

No. 36. *Hircinia ?* —— sp. Sessile, with solid cylindrical erect branches or processes interunited. Consistence resilient. Color now sponge-brown. ? = No. 23. (*Note.*—As the fibre of these *Hirciniæ* was invested with sarcode different from the color of the fibre itself, there is no saying what color the latter was in its natural state.)

No. 52. *Hircinia ?* —— sp. Sarcode destroyed by *Spongiophaga communis*, Crtr. (See "Parasites of the Spongida," Ann., 1878, vol. ii, p. 168.) Look at the white substance under a microscope, to see the filaments of the parasite.

No. 53. *Hircinia ?* —— sp. Branched; branches solid, cylindrical.

No. 54. *Hircinia ?* —— sp. Has grown over sedgy leaves.

No. 55. *Hircinia ?* —— sp. Sessile, composed of erect conical tubes.

Group 16. ARENOSA.

No. 59. *Spongelia*, Sdt., *? avara*, Sdt.

No. 57. *Spongelia avara*, Sdt. Red sarcode (Sp. Adriat. Meeres, p. 29, taf. 3, fig. 6).

No. 51. *Spongelia*, Sdt. ? —— sp. = *Dysidea*, Bk. Fragment much worn.

No. 44. *Spongelia*, Sdt. ? —— sp.

No. 43. *Dysidea*, Bk. Like No. 39, but fibrous. *? Spongelia*, Sdt.

No. 24. *Spongelia*, Sdt., *? pallescens*, Sdt. (Sp. Adriat. Meeres, p. 28). *Dysidea*, Bk.

No. 39. *Dysidea tenerrima*, Crtr. Merely sarcode and sand producing "columnar" structure. No fibre; thus bearing much the same relation to the *Hirciniosa* that the Holorhaphidota do

to the Rhaphidonemata, viz., a minimum of Kerasine (named after its structure).

ORD. IV. RHAPHIDONEMATA.

FAM. 1. CHALINIDA.

Group 1. DIGITATA.

No. 13. *Chalina oculata*, Bk. A delicate growth.
No. 25. *Chalina oculata*, Bk. A form of.
No. 28. *Chalina oculata*, Bk. Has grown over woody stems.
No. 29. *Chalina oculata*, Bk. Short-branched delicate growth.
No. 42. *Chalina oculata*, Bk. Form of.

FAM. 2. CAVOCHALINIDA.

Group 6. ACULEATA.

No. 22. *Tuba sororia*, Duchass. de Fonb. et Michel. (Spongiares de la mer Caraïbe, Pl. 8, fig 2. Harlem, 1864. Also see "Ann." 1882, vol. ix, p. 277, under "Cavochalinida," W. Indian Sponges).

No number. *Tuba sororia* (D. et M., Pl. 8, fig. 2). Covered. with empty holes, formerly the abodes of a parasitic polyp.

ORD. V. ECHINONEMATA.

FAM. 1.

Group 4. ECHINOCLATHRATA.

No. 16. *Echinoclathria* ? —— sp. Dense mass of erect, small, round, short-jointed branches, polychotomously dividing and ending in short processes with rounded terminations; knotty on the surface, chiefly from the presence of a small parasitic polyp. Consistence hard. Color now gray. Texture dense. Spicule of one form only, viz.: acute, short, robust, sub-capitate, the shortest internally and the longest echinating the fibre. Size, about 14 by 1—1800 in. (Like *Clathria coralloides*, Sdt., Sp. Adriat. Meeres, taf. v, figs. 10 and 11.)

No. 27. *Echinoclathria* ? —— sp. The same as No. 16, but with compressed interuniting branches ending in pointed terminations, but no parasitic polyp. Spicule about 18 by 2—1800 in.

No. 30. *Echinoclathria* ? —— sp. Fragment too insignificant for general description. Compressed, interuniting branches, ending in pointed divisions. Consistence firm. Color light sponge-yellow. Fibre short-jointed, bearing internally and externally capitate acuates, the latter the longest and projecting in

tufts, mixed with a small echinating, spinous acuate (? *Dictyocylindrus*, Bk.).

No. 37. *Echinoclathria?* —— sp. Dense mass of compressed, proliferous, interuniting branches arising from a contracted base, growing on the valve of an *Arca*, terminating in compressed, somewhat expanded divisions. Surface subhispid. Consistence hard, tough. Color now brown. Bearing a parasitic polyp (*Palythoa*). Fibre short-jointed, amber-colored, bearing three forms of spicules, viz.: 1, robust, acuate with globular tuberculated head, about 23 by 2—1800 in. in its greatest dimensions; 2, long smooth acuate, 20 by ½—1800 in.; 3, echinating spicule, clavate, spined, small, 6 by ½—1800 in. (*Note.*—If the "tuberculated head" is not an accidental form, it is a markedly distinguishing character.)

No. 38. The same as No. 27.

No. 46. *Echinoclathria?* —— sp. Fragment useless for general form. Flimsy branched, interuniting, ridged. Consistence firm. Color now whitish gray. Fibre tough, short-jointed, amber-colored, bearing two forms of spicule, viz.: 1, large, long and short robust acuates, less in diameter at the large end than in the middle of the shaft; 2, echinating, short spinous acuate.

Fam. 2. AXINELLIDA.

Group 6. Multiformia.

No. 6. *Reniera digitata*, Sdt. (Spong. Adriat. Meeres, p. 75, taf. 7, fig. 11.) Massive, sessile lobate. Surface cellular, roughened by ridges and small processes. Consistence firm. Color orange. Structure cellular. (? A species of the genus *Higginsia*, Higgin, "Ann.," 1877, vol. 19, p. 291; vol. xiv, fig. 1.)

No. 7. *Higginsia coralloides*, Higgin ("Ann.," l. c.).

No. 15. *Axinellid,?* gen. et sp. Fragment shreddy, branching, tough, brown color. Fibre short-jointed, very tough and amber-colored, hispid, bearing three forms of spicules, viz.: 1, robust, simple, acuate, long and short; 2, fine, long, setaceous, acuate; 3, small, navicular anchorate, flesh-spicule. The acuates are situated partly in and partly projecting from the fibre echinatingly, with the anchorate plentifully scattered about their base of attachment. (? *Clathria* Sdt., Sp. Adriat. Meeres).

No. 35. *Axinella polypoides*, Sdt. (Sp. Adriat. Meeres, p. 3, taf. 6, fig. 4).

No. 45. *Higginsia coralloides*, Higgin ("Ann.," l. c.). Erect

branches, compressed interuniting, roughened by small projecting processes. Consistence now hard. Color whitish gray, spicules of two forms, viz.: 1, large acerate, smooth, 40 by 2—1800 in.; 2, small acerate, spinous, partly in and partly out of the fibre, projecting echinatingly from the surface.

ORD. VI. HOLORHAPHIDOTA.

FAM. 1. RENIERIDA.

Group 1. AMORPHOZOA.

No. 5. *Halichondria panicea*, Bk., attached to sea-weed, covered with white *Melobesia*.

No. 12. *Halichondria panicea*, Bk.

No. 34. *Halichondria panicea*, Bk.

No. 58. *Halichondria panicea*, Bk., much worn.

FAM. 2. ISODICTYOSA.

No. 17. *Isodictya*, Bk.? —— sp. Fragment of a branch. Consistence crumbly. Color white. Spicule acerate, 11 by $\frac{3}{4}$—1800 in. (Where the spicule is acerate, which is generally the case, the species are ill-defined, *as yet.*)

Group 3. THALYOSA.

No. 48. *Reniera?* —— sp. Fragment of a cylindrical, solid branch, in which the fibre is entirely composed of small acerate spicules, about 13–1800 in. long. (These species, for the foregoing reason, are, as yet, ill-defined, except where their general form is peculiar.)

No. 49. The same.

Group 6. HALICHONDRINA.

No. 32. *Halichondria incrustans*, Mihi. Variety with "angulated" (Bk.) anchorate and smooth acuate. Consistence crumbly. Color white. Fragment massive, attached to a dark green, dry, gelatinous, now hardened mass, which, if not one of the "Carnosa," is probably the remains of a compound tunicated ascidian.

Suberites par excellence. Groups 10, 11 and 12. Cavernosa, Compacta, Laxa.

10. CAVERNOSA.

No. 3. *Suberites?* —— sp. Fragment useless for general form, as the whole is broken down into a mass of spicular pulp and fibre. Color yellowish. Spicule of one form only, viz., pin-like; shaft smooth, slightly fusiform and curved; head oval; size, 30 by 1—1800 in. (? = No. 18.)

No. 10. *Raphyrus Griffithsii*, Bk. Branched tubular variety, therefore might be designated "ramotubulata," Crtr. (The first instance of *this form* that I have seen.)

No. 11. The same, but the usual massive, solid form. N. B.—It is *Cliona celata*, which, after having destroyed the oyster-shell in which it generally burrows, grows into the *free* form called by Dr. Bowerbank "*Raphyrus Griffithsii*" (Mon., vol. iii, pl. 64).

No. 18. *Suberites?* —— sp. Fragment branched and interuniting most irregularly. Surface covered with short warty and digitiform processes. Consistence light corky. Color ochre-yellow. Structure cellulo-cavernous. Spicule of one form only, viz., pin-like; shaft smooth, slightly fusiform and curved; head oval, often followed towards the shaft, by an annular inflation; size, 30 by 1—1800 in.

No. 33. *Suberites?* —— sp. Fragment useless for general form; further than that it is very irregular and interuniting, suberite-like. Consistence firm. Color white. Structure cancello-cavernous. Spicule of one form only, viz., pin-like; shaft smooth, slightly fusiform and curved; head globo-conical; about 65 by 1—1800 in.

No. 1. *Suberites?* —— sp. Massive, erect, sessile, terminating in small, conical processes. Consistence now firm. Color gray outside, yellowish inside. Structure cancello-cavernous. Spicule of one form only, viz., pin-like; shaft smooth, slightly fusiform and curved; head nearly oval; point obtusely rounded; size 25 by 1—1800 in. in its greatest dimensions. (If the obtuseness of the point is not accidental, this is a good character.)

11. Compacta.

No. 4. *Suberites?* —— sp. Taking the form of the Serpula-tubes over which it has grown, interuniting and enclosing shells. Consistence hard now and compact. Surface villous. Color yellowish gray. Spicule of one form only, viz., pin-like; shaft smooth, slightly fusiform and curved; head oval, often prolonged posteriorly; size 50 by 1—1800 in.

No. 8. *Suberites?* —— sp. Taking its form from the sedgy leaves over which it has grown. Consistence cheesy, now hard. Color greenish outside (adventitious ?), yellowish within. Like *Hymeniacedon carnosa*, Bk., in consistence and structure, if not in the form of the head of the spicule.

No. 40. *Suberites ?* —— sp. Irregularly branched, interuniting, ending in round-topped processes. Consistence compact. Color reddish yellow. Spicule of one form only, viz., pin-like; head globular with posterior projection, tricuspid like in profile. (? *Suberites marsa*, Sdt., Sp. Adriat. Meeres, p. 67, taf. 7, fig. 2.)

12. LAXA.

No. 20. *Halichondria sanguinea*, Bk. (Mon., vol. iii, pl. 32, fig. 5).

FAM. 13. DONATINA.

No. 47. *Tethya lyncurium*, Bk. (pl. 15, fig. 17, op. cit.). Robust form with large cavernous excavations on the surface, and bundles of spicules sunk in the dry, dark, chondroid tissue.

FAM. 14. GEODINA.

No. 21. *Geodia tuberculosa*, Bk. (Proc. Zool. Soc., 1872, p. 676, pl. 46).

No. 50. The same. Cylindrical fragment.

ORD. VIII. CALCAREA.

No. 9. *Ascaltis Lamarckii*, Hæckel (Die Kalkschwämme, vol. 2, p. 60, Atlas, taf. 9, fig. 5). Massive, growing among sand and round the stems of sea-weed. Enveloping sand. (*Clathrina*, Gray.)

Numbers absent, viz., 2, 14 and 56.

OBSERVATIONS.

Lest it should be thought that it is only necessary to present a fragment of a sponge to have its name and description pointed out as readily as this might be done with a plant in botany, the former being expected from the accumulated product of a few years, while the latter is one of centuries, I would append the following remarks on the above "Catalogue":—

The family of *Hircinida* requires to be generally reviewed, but the time for this has not arrived, since if not by actual specimens preserved when fresh in a *wet* state, it must be done by a review of all the illustrated descriptions of this kind that have been published; while considering that the specimens of *Hircinida* are exceedingly numerous and *very much* alike, nothing but an opportunity of this kind holds out any hope of their ever being collated, divided and finally arranged in such a manner as would be useful to the student. In the spiculiferous sponges the form of the spicule often facilitates this, but in the *Hircinida* generally,

when divested of the sarcode, which often has a particular color, there is absolutely nothing left but the horny fibre covered with a heterogeneous assemblage of foreign objects, viz., sand, fragmentary sponge-spicules and other microscopic bodies, which vary in amount and kind with those which are most plentiful in the locality where the sponge may be growing, if we except the general form which the skeletons composed of this fibre may retain.

The *Suberites par excellence*, too, like the *Hirciniæ*, require a similar treatment, for here the skeletal spicule, being for the most part simply *pin-like*, is so similar and so slightly varied in form, that, in most instances, this alone would be insufficient for distinction. However, the skeletal spicule is often accompanied by a flesh-spicule of a spini-spirular or other form, which lessens the difficulty; but they can seldom be seen without mounting a microscopic fragment in balsam, when the transparency renders them (if there are any) plain, which the *wet* sarcode previously rendered obscure. This should be done with all the specimens *above mentioned*, as it involves an amount of time which I now have not at my disposal; hence can only recommend the student to consult my initiatory attempt to do this in the "Annals" of 1882 ("West Indian Sponges," etc., vol. 9, p. 349, etc., pl. xii, figs. 25–30).

See also, for the group Donatina and species *Donatia lyncurium*, "General observations" (Ib. ib., p. 358, etc.).

In my division of the Echinonemata, the first groups of the families Ectyonida and Axinellida respectively, viz., "1" and "6" *i. e.* "Pluriformia" and "Multiformia" are merely *provisional* terms for including a vast number of species which hereafter will have to undergo description, illustration and division, when they shall have been usefully collated, etc., after the manner already mentioned, but so much time, taste, labor and opportunity will be required for this, that many years must pass before it even approaches completion.

The number of species of sponges that exist and have still to be discovered has been chiefly foreshadowed to me by the *dry* specimens in the British Museum, upon which my proposed "Classification" has been based, but cannot be put forth with any certainty under such circumstances, more especially the subdivision of the orders.

JULY 22.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Eleven persons present.

JULY 29.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Eight persons present.

Sexual Characteristics in Zinnia.—Mr. THOMAS MEEHAN, referring to some so-called double Zinnias on the table, remarked on the change of sexual character which followed the change of a tubular to a ligulate floret This was not confined to *Zinnia*, but occurred in *Dahlia*, and, he believed, all composite flowers. It must be a well-known fact, but had not, so far as he knew, been placed on record. It was well worthy of study by those interested in the laws of sex. In *Zinnia* a single ligulate floret would often be surrounded by tubular and hermaphrodite ones; but it would have the purely pistillate character of the ray florets. In like manner, when, in the double Dahlia, the tubular florets became ligulate, the neutral character of the ray florets followed with them. It was evident that in these cases there was an intimate connection between the form of the floret and its sexual character. There was even a difference in the form of the akene in the different florets of *Zinnia*. The ligulate female floret had a broad akene, tapering at the summit, and with the apex very hairy; while the akene of the tubular hermaphrodite floret was truncate, and entirely smooth.

He made some further remarks on the growth of the floret in connection with that of the staminal tube. In many compositæ the growth of the pistil continued for a day or two after the corolla had ceased to grow, pushing up often to a length double that of the corolla. In *Zinnia* the growth of the floret was enormous on the last day, often doubling its previous length in twenty-four hours. It always remained longer than the pistil, until it withered away, when the expanded arms of the pistil were exposed. The anther cells burst before the floret opened, and, though the arms could not expand, enough pollen entered by the stigmatic fissure to ensure self-fertilization.

The following was ordered to be printed:—

DESCRIPTION OF NEW SPECIES OF TERRESTRIAL MOLLUSCA OF CUBA.

BY RAFAEL ARANGO.

Choanopoma uncinatum Arango (fig. 1).

Testa subperforata, oblongo pupæformis, teniuscula, truncata, filoso costata, furcescenti-albida, seriebus macularum rufarum longitudinaliter ornata; sutura profunda, costis excurrentibus incrassatis albido-dentata; anfr. superst. 4–5 convexiusculi, ultimus antice solutus, dorso carinatus; apertura verticalis, ovalis; peritrema duplex, internum breve, externum dilatatum, lateri dextro latiore, undulato, in angulo supero uncinato reflexum. Operculum normale.

1.

Long. 16 mill.; diam. 7 mill.; apert. 4 mill.

Habitat.—*San Juan de las Lleras*, prope Villaclara.

Simillimum *Tudoræ Moreletianæ*, differt operculo *Choanopomatum* et forma altera peritrematis.

Cylindrella assimilis Arango (fig. 2).

Testa simillima *Cyl. arcustriatæ*. Differt statura magis cylindrica, costis minus confertis, fortioribus; fasciis spadicea suturam anfractus sequentis tangente et prope peri trema expansum terminante (magis conspicua quam in *arcustriata*). Anfractus 12 testæ integræ.

Long. 23–26 mill.; diam. 6 mill.; apert. 4 mill.

Habitat.—*La Iagua*, prope La Palma in provincia Pinar del Rio.

2.

Cylindrella contentiosa Arango.

Testa vix rimata, fusiformi-turrita, fusco-cornea, pallidæ pauce variegata; spira sursum sensim attenuata; truncata; sutura subcrenulata; anfr. superst. 14–15 planulati, ultimus adnatus, basi filoso-carinatus; apertura subcircularis; peritrema undique æqualiter expansum, album.

Long. testæ truncatæ 14–16 mill.; diam. 3 mill.

Columna interna lamina unica acuta oblique circumvoluta.

Habitat.—*San Juan de las Lleras*, prope Villaclara.

Cylindrella Lejoncherei Arango.

Testa fusiformi-elongata, gracilis, subtruncata, tenuis, suboblique costata, diaphana, albida; anfr. superst. 15–17, ultimus solutus, deorsum protractus; sutura simplex; apertura oblique circularis, peritrema undique breviter expansum.

Long. 15–17 mill.; diam. 2½ mill.

Columna interna filoso-torta.

Habitat.—*San Juan de las Lleras*, prope Villaclara.

Similis *Cyl. Philippianæ*, differt forma longiori, costis remotioribus et colore albido (nec fusculo-variegato).

Cylindrella Thomsoni Arango (fig. 3).

Testa similis *Cyl. coloratæ* (vide descriptionem) sed differt statura magis cylindrica, colore corneo, testa pellucida, fascia spadicea solummodo in anfractu ultimo visible. Anfractus 14 testæ integræ.

Habitat.—"*La Iagua*," prope La Palma in provincia Pinar del Rio.

3.

Cylindrella infortunata Arango (fig. 4).

Proc. Acad. Nat. Sc. of Phila., 1882, p. 106.

Testa non rimata, subfusiformi-turrita, tenuis, diaphana, chordato-costata, albido-cornea; spira breviter truncata; sutura profunda, non crenulata; anfr. superstites 12, planiusculi, ultimus breviter solutus; basi obsolete carinatus; apertura subovalis; peritrema expansiusculum, album.

4.

Longitud. testæ truncatæ 13 mill.; diam. 3 mill.

Columna interna 3-plicata, plica superiori ampliori.

Habitat.—Prædium "*La Chorera*," municipium Viñales, in provincia Pinar del Rio.

Cylindrella colorata Arango (fig. 5).

Proc. Acad. Nat. Sciences, 1882, p. 106.

A figure of this species is now given from a type specimen.

5.

AUGUST 5.

Mr. EDW. POTTS in the chair.

Eleven persons present.

On Paludicella erecta.—Mr. EDWARD POTTS desired to have a preliminary record made of his recent discovery or identification of a new species of *Paludicella*, for which he proposes the name *Paludicella erecta.*

This genus of fresh-water polyps has heretofore contained only the single clearly defined species *P. Ehrenbergi*, Van Beneden (*Alcyonella articulata*, Ehrenberg), the other two names, *P. procumbens* and *P. elongata*, suggested by Mr. Albany Hancock and Prof. Leidy, being considered by Prof. Allman as identical with the original type. The present form is strikingly different from the old one, both in the number of its ciliated tentacles and in the character of the cœnœcial cells. The doubt which has lingered in the mind of the speaker has not been as to the species, but whether, in view of the difficult determination of the characteristic septæ between the cells, amounting in fact to an apparent absence of them, a new genus might not be required to accommodate it.

It was first noticed in Tacony Creek, a small stream in Montgomery County, Pennsylvania, at that place perhaps fifty feet above tide-water. A few days after it was also gathered within tidal limits in both the Delaware and Schuylkill Rivers, near Philadelphia. In the first-named locality it was found most abundantly in the pools amongst the rapids of the stream, frequently covering the upper surface of stones, at the depth of a foot or more, to the extent of many square inches. The erect portions of the cœnœcial cells in the denser parts of the colonies are about a line in height and, standing very closely, suggest a comparison with the surface of a chestnut-burr. In the rivers they were found penetrating the mass of encrusting sponges, particularly *Meyenia Leidyi.*

These upright tubules are chitinous prolongations of very irregularly inflated cells, resting in compact disorder upon the supporting surface, crossed and connected in some manner not yet intelligible, by meandering cylindrical rhizomes, sometimes of great relative length. These are mostly terminal and simple, but are sometimes branched and frequently originate in an indifferent lateral portion of a cell. The tubular prolongations are, of course, always single; the invaginated polyp retiring within the inflated portion of the cell. Septæ were, in a few instances, discovered in the rhizomes near their insertion or connection with the inflated portion of the cells. The upright

portions of those cells which seemed to be least matured were longer than those of their older neighbors, subclavate or spindle-shaped and rounded at the extremities. The others are cylindrical or slightly widening downwards and shorter than the former by the invagination of the terminal portion of the ectocyst. This has the effect of producing the angular appearance of the orifice, so familiar in the older species; but while that is generally quadrangular, this has frequently five or more sides. The younger cells are nearly transparent, but they darken with age and become somewhat encrusted with adherent particles and overgrown by commensal parasites, *Limnias*, *Pyxicola*, and the like.

The polypides are shy, but fond of the light, and when otherwise undisturbed will remain for a long time protruded in the full glare of microscopic illumination. It can then be seen that the lophophore is circular, without epistome, supporting ordinarily twenty tentacles, taking the shape of a claret glass and opening upwards. (Nineteen and twenty-one tentacles have been doubtfully counted, while the above-mentioned number is frequent; *P. Ehrenbergi* is universally stated to have but sixteen). A peculiarity of the tentacles is the presence upon the outer median line of each, of a rather sparsely filled series of quiescent setæ, in strong contrast with the rapidly moving cilia around them.

The development of this polyp from the ovum, of which interesting hints have been obtained, and its internal structural peculiarities, are reserved for further study, and if satisfactory results shall have been attained, they will be treated of in a later paper. The nearly simultaneous observation of this species in three distinct localities, and its abundance in each, indicates that it is probably not uncommon, and excites surprise that it does not appear to have been previously noticed.

AUGUST 12.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Fifteen persons present.

A Large Zircon.—Dr. A. E. FOOTE recorded the discovery of the largest crystal of zircon ever known. It is 9½ inches high, 4 inches on one face and 3⅝ inches on the other. It undoubtedly originally weighed twelve pounds, but owing to a small portion being lost by fracturing it now weighs but eleven and three-quarter pounds. The largest crystal ever known before weighed less than three pounds. The crystal is doubly terminated, and, though somewhat broken in taking out nearly all the pieces were saved. At one end there are two terminations and one of these

was broken off in some great convulsion of the earth's surface. This had been separated from the main crystal by a piece of orthoclase that had unmistakably been formed since the rupture of the crystal. Such a fact is of great importance in studying the geological history of the formation. The locality is Brudinelle, Renfrew Co., Ontario, Canada, and the rock is a vein of pink feldspar in a Laurentian gneiss. It is associated with sphene and crystals of peristerite (?). Some of the faces of the latter show the moonstone reflections very plainly. Cavities once filled with calcite (now mostly dissolved away) occur in the vein. There are also some small crystals that need further examination.

AUGUST 19.

Mr. J. H. REDFIELD in the chair.

Fifteen persons present.

The death of W. L. Schaeffer, a member, was announced.

AUGUST 26.

Mr. J. H. REDFIELD in the chair.

Fourteen persons present.

The death of James L. Claghorn, a member, was announced.

Edward P. Bliss and Ralph W. Seiss, M.D., were elected members.

SEPTEMBER 2.

Rev. H. C. MCCOOK, D.D., Vice-President, in the chair.

Twenty-one persons present.

On the wide Distribution of some American Sponges.—Allusion having been made to the wide distribution of certain species of spiders over the North American continent, Mr. E. POTTS, referring to the fresh-water sponge fauna of this country, said, that *Spongilla fragilis*, the first species named in America, described by Dr. Leidy in 1851 from specimens collected near Philadelphia, had since been found abundantly along the Atlantic coast from Florida to Nova Scotia. It had been gathered at several points along the St. Lawrence and in the great lakes, through the middle continent, and in the far west had been described by Dr. Bowerbank, in 1863, under the name of *S. Lordii*, as found in the lakes and streams flowing from the Cascade Range in British Columbia,

affluents of the majestic Columbia River. The species may, therefore, be regarded as strictly continental in its range, and until very recently it has been distinctively American. It is a little singular that the only other place in which it has been noticed is in the neighborhood of Charkow, in Russia, where it was discovered, a few months since, by Dr. L. Dybowski.

The specimens of this species from Nova Scotia had been collected by Mr. A. H. Mackay, B. A., B. S., of Pictou Academy, Pictou. N. S., from whom the speaker had recently received a collection of sponges, phenomenal in its character, both as regards the number of genera and species represented, and the excellent judgment that had attached to most of them their proper names, from apparently very insufficient data. The collection was the result of few days' search within a limited district, "from lakes in and near the water shed of Nova Scotia, near the borders of the three counties of Pictou, Guysboro and Antigonish," at elevations of from 100 to 700 feet above sea level. Of the genus *Spongilla*, it contains three species, *S. lacustris*, *S. fragilis*, and *S. iglooiformis*; of the genus *Meyenia*, two species, *M. fluviatilis* and *M. Everetti*; of the genus *Heteromeyenia*, two, *H. argyrosperma* and *H. Ryderi*, and of the genus *Tubella*, one species, *T. Pennsylvanica*—eight species, representing four genera. Besides these there were small specimens of another species, evidently new, but whose genus relations could not be determined on account of the absence of statoblasts.

In some respects the most important find in the collection is *Meyenia Everetti* Mills; this being only the second instance in which the species has been discovered. The original locality was Gilder Pond upon Mt. Everett, in Berkshire Co., Mass., at an elevation of 1800 or 2000 feet above the sea. It was there collected by Dr. F. Wolle and Mr. H. S. Kitchel of Bethlehem, Pa., well known for their invaluable work among the desmids and diatoms; and examined simultaneously by Mr. H. Mills of Buffalo, N. Y., and the speaker. Its most striking peculiarity is the presence, all through the dermal tissues, of very minute birotulate spicules, the only instance in which these have been observed as characteristic features of the dermal surface in any fresh-water sponges; unless the complicated forms found in *Meyenia plumosa* Carter, may be considered an exception.

These birotulates in the present collection average one-third longer than those before examined, and are in every way more robust. The speaker was gratified in finding this confirmation of a rule which he has long since observed to hold amongst the infinite variations of size and form noticeable in collections of the same species from various localities; viz., that the spicules of all species increase regularly in size and solidity as we descend from high altitudes towards the sea-level, where is found the extreme limit of the series. He does not attribute this gradation to a change of climatic conditions, but more probably to a gradual and con-

stant improvement in the food-supply or in the siliceous constituent of the water. He has traced the workings of the rule more particularly through the very variable species, *Spongilla lacustris* and *S. fragilis;* in *Meyenia fluviatilis*, in *Heteromeyenia argyrosperma* and *H. Ryderi*, and lastly and most conspicuously in *Tubella Pennsylvanica*. The extremes in this last series differ so widely that they would hardly be taken to belong to the same species, but the intermediate grades have all been collected, largely from the same stream; and as a result several species named in this and other cases, have relapsed into synonyms.

SEPTEMBER 9.

Dr. W. S. W. RUSCHENBERGER, in the chair.

Eleven persons present.

The death of R. E. Rogers, M. D., a member, was announced.

SEPTEMBER 16.

Rev. H. C. McCOOK, D. D., Vice-President, in the chair.

Seventeen persons present.

On the Minute Fauna of Fairmount Reservoir.—Mr. E. POTTS alluded to the difficulties that ordinarily prevent a thorough study of the fixed aquatic fauna, which he described as thereby generally limited to collections from the shallow water near the margins of lakes and streams, or of such forms as may adhere to the few timbers or stones that can be dragged from a greater depth. He therefore urged the importance of making use of such opportunities as are furnished by the temporary drainage of reservoirs, canals, etc., to examine thoroughly the incrustations upon exposed walls and timbers, or on the bed of the stream.

Such an occasion was afforded a few days since, when the accidental breaking of a valve necessitated the drawing off of the water from the Fairmount reservoirs. These are divided by perpendicular walls, eight or ten feet in height, and, unfortunately, facilities were not at hand in the shape of ladders, planks, etc., to enable him to make a minute examination of them. From the margin, however, could be seen at many places patches of the sponges, *Spongilla fragilis* and *Meyenia fluviatilis*, while the cages over the outlet pipes, and, more strikingly, the walls surrounding the main outlet at the southeast corner, were thickly encrusted with *Meyenia Leidyi*. The last-named sponge is very compact and little liable to crumble during the winter season, so that it is probable that the large masses, some of them nearly an inch in thick-

ness, and a foot or two in diameter, represent the aggregation of several years. In a few places, at the base of the walls, the pale green branches of *Spongilla lacustris* could be seen, and occasionally, to the speaker's surprise, slender waving processes of the same species, totally colorless, could be seen reaching up through the mud in little groups upon the bottom. He was surprised, because he had always held that it was impossible for sponges to live upon a muddy bottom, and theoretic reasoning would still suggest that probably only this species, which can thus hold itself up out of the suffocating silt, can survive the constant deposition of siliceous particles. The total amount of sponge growth was relatively small, and the probability of an aqueous taint from it, very remote.

The commensal habit of many of the lower animals who feed by the creation of ciliary whirlpool currents, has been frequently referred to; the weaker current-makers, such as vorticellæ, stentors, and the errant and tubicolous rotifers, planting themselves about the heads of the stronger polyzoa to supply their own nets with what may have escaped from the others. The same instinctive principle which leads all these to locate themselves most plentifully amongst the stones in the rapids of streams, was particularly noticeable in promoting their aggregation upon and in the neighborhood of the inlet and outlet gates of the reservoirs. The feeble currents produced by each can only bring within its reach the floating provision from a very limited area; the volume of water poured through these gates brings to them a rich supply, and the numbers and variety of these organisms increase in proportion. Of the fixed forms were seen amongst the bryozoa, beside one or more undetermined species of *Plumatella*—*Pectinatella magnifica* and *Urnatella gracilis* of Leidy, and the newly described *Paludicella erecta*. Attached to these were Vorticellæ, Epistilis and Stentors innumerable; *Pyxicola* and *Acineta;* rotifers of various names, including prominently *Limnias* and other, probably undescribed forms among the Melicertidæ. Very abundant among these was the interesting chætobranch annelid, *Manayunkia speciosa* Leidy, which has of late been frequently noticed in this vicinity, and the wonderfully marine-looking hydroid *Cordylophora lacustris*. This last was particularly abundant around the southeast outlet; its stems forming a complete matting over many yards of surface, commingled with bryozoa and sponges in intricate confusion.

A large valve had been removed from a discharging main on the southern side of the reservoir hill, a hundred yards or more from the opening in the bottom of one of the basins, and where all light was consequently absent. An incrustation, averaging perhaps three-eighths of an inch in thickness, upon the inner surface of this valve, was found to be largely composed of the gemmulæ and spicules of *Meyenia Leidyi;* mingled with which were stems of

Plumatella, *Urnatella*, and *Cordylophora lacustris.* The fact that all these can thus thrive in absolute darkness throws some doubt upon the supposed sensitiveness of these forms to the presence or absence of light, as does also the fact that while *Paludicella Ehrenbergi* is said to seek the darkest corners, the speaker found his new species, *P. erecta*, apparently rejoicing in the glare of the full sunlight.

Of course many other creatures than those above named were casually seen in this connection, including chiefly amœbæ, free-swimming protozoans and entomostracans, planarian worms, hydras and aquatic insect-larvæ; but the former are particularly mentioned as among the most interesting and beautiful of those that freely and innocently drink of the same cup with ourselves.

SEPTEMBER 23.

Mr. EDW. POTTS, in the chair.

Nine persons present.

The following papers were presented for publication:—

"A Review of the American Species of the Genus Hemiramphus," by Seth E. Meek and David K. Goss.

"A Review of the American Species of the Genus Teuthis," by Seth E. Meek and Martin L. Hoffman.

"A Review of the American Species of Scomberomorus," by Seth E. Meek and Robert G. Newland.

Tunisian Flints.—Dr. D. G. BRINTON remarked that the flints presented through him this evening had been received from the eminent archæologist, the Marquis de Nadaillac, whose son, an officer in the French army, obtained them at the station of Ras-el-Oued, near Biban, on the southeastern coast of Tunis. The specimens consist of flint chips, arrow-points, and a semi-lunar shaped implement of small size, which resembles the "stemmed scrapers" found in America. This form was obtained from the lower levels, and is characteristic, in France, of the later productions of the stone age, especially of that epoch called by French archæologists "the epoch of Robenhausen," from the locality of that name in Switzerland. Chronologically, this is the first epoch of the appearance of man on the globe, the previous implement-using animals being more properly anthropoids. Those made use of stone only, not having learned the dressing of bone or horn. This view adds to the interest of the query as to the purpose of these scrapers, as they are called in default of a better name. That they were an important tool to the primitive man is evident from their wide distribution. They have been found in

France, in the Crimea, in India, in America, in strata of great antiquity (both North and South America), and here we have them in Africa.

The archæology of the North African Coast has special claims to attention, as from there apparently a very ancient migration advanced northward, passing in one direction through Spain, and in another by way of Malta, Sicily and Italy. This was cotemporary with the appearance of the *Elephas Africanus* in Europe, whose bones have been found in intimate association with those of man in various localities. It was long anterior to the immigration of the Iberians or Basques, who by some are traced to North Africa. Another point of interest may be added. The only locality in the Old World where animal or effigy mounds have been reported is in North Africa, in Algiers, near the forest of Tenrit-el-Sad, south of Miliana. As these peculiar structures are so frequent in the Mississippi Valley, the coincidence is worth noting.

Prof. Heilprin contended, that while on the hypothesis of evolution no objection could be raised to an assumption which made an animal intermediate between man and the anthropoid apes sufficiently intelligent to understand the full value and manufacture of stone implements such as were exhibited, yet, as a matter of fact, paleontological evidence had thus far failed to prove that any such use or manufacture had been made of them, as was here claimed. Indeed, no evidence was forthcoming to show that the implements were not the work of man himself, despite the fact that no traces of human remains were found associated with the fragments. The assumption that the advent of man dates only to a given period of the so-called "stone age," was considered to be purely gratuitous, and to rest solely on negative evidence. Many archæologists concur in the belief that his remains may yet be found in deposits of strictly Tertiary age, and some, even in the early part of this period. The speaker discussed the theory of the migration of races, and the successive introduction, into different regions, at different periods of time, of the various epochs marking the development of the human race.

September 30.

Mr. Edw. Potts in the chair.

Twenty-four persons present.

Henry F. Osborn, John Wanamaker, and Miss Adele M. Fielde were elected members.

The following were ordered to be printed :—

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS HEMIRHAMPHUS.

BY SETH E. MEEK AND DAVID K. GOSS.

The American species of the genus *Hemirhamphus* are in a condition of great confusion. In this paper we have endeavored to give the synonyms of those species which seem to be valid, with an analysis of their specific characters. The paper is based on specimens belonging to the Indiana University, and to the United States National Museum, all of them collected by Professor David S. Jordan on the coast of Florida and at Havana.

This collection comprises three of the four Atlantic species admitted by us, the published descriptions indicating the existence of another (*H. balao*), as yet unknown to us.

Euleptorhamphus longirostris is not here mentioned, as we regard it as the type of a genus distinct from *Hemirhamphus*.

We are very much indebted to Professor Jordan for use of his library and for valuable aid.

Analysis of American species of the genus Hemirhamphus.

a. Anal fin about as long as dorsal and opposite it, its rays 14 to 16; sides with a distinct silvery band; last ray of dorsal not produced in a filament.

b. Ventrals inserted about midway between base of caudal and posterior margin of eye; dorsal and anal fins scaly; lat. l. 53 to 56.

c. Length of mandible (from tip of upper jaw) not longer than rest of head; body and head comparatively robust; D. 15; A. 16. *unifasciatus*. 1.

cc. Length of mandible (from tip of upper jaw) not shorter than rest of head; body comparatively slender. D. 14; A. 15. *roberti*. 2.

bb. Ventrals inserted midway between base of caudal and gill openings; dorsal and anal fins not scaly; lat. l. 63; D. 14; A. 14. *rosæ*. 3.

aa. Anal fin about $\frac{2}{3}$ length of dorsal, its insertion behind that of dorsal, its rays 11 or 12; sides without distinct silvery band; last ray of dorsal produced in a short filament.

d. Scales comparatively large, about 53 in lateral line; upper lobe of caudal bright orange in life. D. 14; A. 12. *pleii*. 4.

dd. Scales comparatively small, about 63 in lateral line (*Valenciennes*); upper lobe of caudal dirty violet (*Poey*); D. 11–14; A. 11–12 (*Poey*). *balao*. 5.

1. **Hemirhamphus unifasciatus.**

Hemirhamphus unifasciatus Ranzani, Nov. Comm. Acad. Sci. Inst., Bonon, v, 1842, 326, Taf. 25 (Brazil); Günther, Cat. Fish. Brit. Mus., vi, 1866, 262 (in part; West Indies; Rio Janeiro); Cope, Trans. Amer. Phil. Soc., 1871, 481 (St. Martin's); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 924 (Panama; no description). (Not *H. unifasciatus* of most American writers.)

? *Hemirhamphus picarti* Cuv. & Val., Hist. Nat. Poiss., xix, 1846, 25 (Africa).

Hemirhamphus richardi Cuvier & Valenciennes, Hist. Nat. Poiss., xix, 1846, 26 (Antilles; Cayenne; Bahia; Rio Janeiro).

Hyporhamphus tricuspidatus Gill, Proc. Acad. Nat. Sci. Phila., 1859, 131 (Barbadoes).

Hemirhamphus fasciatus Poey, Memorias, ii, 1860, 299 (Cuba; not of Bleeker).

Hemirhamphus poeyi Günther, Cat. Fish. Brit. Mus., vi, 1866, 262 (on *H. fasciatus* Poey); Poey, Syn. Pisc. Cub., 1868, 383 (Cuba); Poey, Enumeration Pisc. Cub., 1875, 121 (Cuba); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 273, 381 (Panama).

Habitat.—Both coasts of tropical America and West Indies; Panama; Cuba; West Indies; Antilles; St. Martin's; Rio Janeiro; Cayenne; Bahia.

This species is known to us from many specimens collected by Professor Jordan at Havana and Key West. Young examples are more slender than the old ones, and have the lower jaw proportionately shorter. Both young and old are, however, more robust, shorter and thicker in every part than specimens of *H. roberti* of the same size. Except this difference of form, we are unable to detect any distinction whatever. We have no doubt, however, that the two are really different.

The figure and description of Ranzani represents this species much better than *H. roberti.* We therefore retain for it his original name. *H. richardi* Cuvier & Valenciennes is evidently the same, and *H. picarti* is at least very similar. Gill's *Hyporhamphus tricuspidatus* is not very satisfactorily described, but as its author afterwards refers to it as probably identical with *H. richardi*, and as the description and locality best fit that species, we have so considered it.

Our Havana specimens leave no doubt that *H. fasciatus* and its synonym, *H. poeyi*, are based on this species. Its lower jaw is, however, longer than Poey describes, and but for this Dr. Günther would evidently have referred Poey's description to *H. unifasciatus.* Specimens collected by Captain Dow, at Havana, show that this is one of the species found on both sides of the isthmus.

2. Hemirhamphus roberti.

Hemirhamphus roberti Cuvier & Valenciennes, Hist. Nat. Poiss., xix, 1846, 24 (Cayenne); Günther, Cat. Fish. Brit. Mus., vi, 1866, 263 (New Orleans).

Hemirhamphus unifasciatus Cope, Proc. Acad. Nat. Sci. Phila., 1870, 119 (Newport, R. I.; Jordan and Gilbert, Proc. U. S. Nat. Mus., 1878, 383 (Beaufort, N. C.), no description; Goode, Proc. U. S. Nat. Mus., 1879, 116 (Name only); Jordan, Proc. U. S. Nat. Mus., 1880, 20 (San Sebastian River, Fla.); Jordan, Proc. U. S. Nat. Mus., 1880, 23 (St. John's River, Fla.), no description; Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas); Jordan and Gilbert, Bull. U. S. Fish Comm., 1882, 106 (Mazatlan); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 588 (Charleston, S. C.); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 356 (Cape San Lucas); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 262 (Pensacola, Fla.); Goode and Bean, Proc. U. S. Nat. Mus., 1882, 239 (Gulf of Mexico), no description; Jordan and Gilbert, Syn. Fish. N. A., 1882, 376.

Habitat.—Both coasts of America, chiefly north of the tropics: Beaufort; Charleston; Pensacola, San Sebastian River; Cedar Keys; New Orleans; Cayenne; Mazatlan; Guaymas; Cape San Lucas.

All the specimens of *Hemirhamphus* thus far taken on the Atlantic Coast of the United States, north of the Florida Keys (except one of *H. pleii*), belong to a species differing from the West Indian *unifasciatus*, in the slenderness of body and in the greater length of the lower jaw. This is evidently the *H. roberti*

of Günther and the *H. unifasciatus* of all the American local lists. The *H. roberti* of Cuvier and Valenciennes is very scantily described. It is, however, related to *H. unifasciatus*, and is said to have the lower jaw longer than in *H. richardi* or *H. picarti*. We therefore identify it with this species, with this element of doubt, that there is no other record of the slender form south of Central Florida. This species occurs also in the Gulf of California. Specimens from Charleston and from Mazatlan are described by Jordan and Gilbert, as having the anterior rays of dorsal and anal, and the upper and lower rays of caudal jet-black, but no other difference from the usual form was noted.

3. **Hemirhamphus rosæ.**

Hemirhamphus, sp. incert., Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 29 (San Diego).

Hemirhamphus rosæ Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 335 (San Diego, Cal.); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 457 (San Pedro, San Diego); Jordan and Jouy, Proc. U. S. Nat. Mus., 1881, 13 (San Diego); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 43 (San Diego); Bean, Proc. U. S. Nat. Mus., 1881, 316 (name only); Jordan and Gilbert, Syn. Fish. N. A., 1882, 376.

Habitat.—Pacific Coast of United States; San Diego; San Pedro.

We have nothing to add to the account of this species.

4. **Hemirhamphus pleii.**

Hemirhamphus marginatus Le Sueur, Jour. Acad. Nat. Sci. Phila., ii, 1823, 135 (Lesser Antilles; not of Forskål).

Hemirhamphus pleii Cuvier & Valenciennes, Hist. Nat. Poiss., xix, 1846, 29 (Antilles; Martinique; San Domingo); Günther, Cat. Fish. Brit. Mus., vi, 1866, 269 (Jamaica; Dominica; Bahia; West Indies); Bean, Proc. U. S. Nat. Mus., 1880, 103 (Bermudas).

Hemirhamphus filamentosus Poey, Syn. Pisc. Cub., 1868, 382 (Cuba); Poey, Enum. Pisc. Cub., 1875, 121 (Cuba).

Hemirhamphus brasiliensis Jordan & Gilbert, Syn. Fish. N. A., 1882, 902 (Hunger's Wharf, Virginia; not of Günther).

Habitat.—Atlantic Coasts of America and West Indies, Virginia to Brazil. Virginia; Martinique; San Domingo; Jamaica; Dominica; Bermudas; Bahia.

This species is very abundant at Key West, where it is known as *Balao*, and at Havana, where it is called *Escribano*. It occa-

sionally ranges northward, a specimen from Virginia being in the National Museum. This is evidently *Hemirhamphus filamentosus* of Poey. The scanty description of *H. pleii* of Cuvier and Valenciennes seems to refer to it, at least in large part, as this is the only species so far as known that has the upper lobe of the caudal red or yellow in life. This is also the *H. marginatus* of Le Sueur, but not the original *H. marginatus* of Forskål.

4. Hemirhamphus balao.

? *Esox maxilla inferiore producta* Brown, Jamaica, 1756, 443, t. 45, f. 2 (Jamaica).

Esox brasiliensis Linnæus, Syst. Nat., ed. 10, 1758, 314 (in part; reference to Brown; not *Timucu* Marcgrave, which should be regarded as the Linnæan type, as having given rise to the name *brasiliensis*).

Hemirhamphus brasiliensis Günther, Cat. Fish. Brit. Mus., vi, 1866, 270 (based on *Hemirhamphus browni* Cuv. and Val.); ? Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 109 (Panama; name only); ? Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 624 (Panama).

Hemirhamphus balao Le Sueur, Jour. Acad. Nat. Sci., Phila., ii, 1823. 135 (Lesser Antilles).

Hemirhamphus browni Cuvier & Valenciennes, Hist. Nat. Poiss., xix, 1846, 13 (Guadaloupe; Martinique).

Hemirhamphus macrochirus Poey, Memorias, ii, 1858, 299 (Cuba); Poey, Enum. Pisc. Cub., 1875, 121 (Cuba).

Habitat. — Coasts of tropical America and West Indies; Jamaica; Lesser Antilles; Guadaloupe; Martinique; Cuba; Panama.

We have not seen this species and are not entirely certain of its distinction from *H. pleii*. In *Hemirhamphus pleii* the upper lobe of the caudal is always bright orange-red and the number of scales in a longitudinal series is about 56. The description of *H. balao*, *H. browni* and *H. macrochirus* all refer to a fish with smaller scales, with both lobes of the caudal bluish, and *H. browni* and *H. macrochirus* have smaller scales than *H. pleii*. The specimens obtained by Professor Gilbert at Mazatlan, Panama, we refer provisionally to this species, but they may prove different on actual comparison. The oldest tenable name for this species seems to be *H. balao* Le Sueur.

Esox brasiliensis Linnæus is based on Brown's description of a *Hemirhamphus* from Jamaica, and Marcgrave's account of a

Tylosurus from Brazil. The name *brasiliensis* is evidently suggested by the latter, which should therefore retain it as specific name. It does not appear also certain as to which species of *Hemirhamphus* is described by Brown.

TABLE OF MEASUREMENTS.

(In hundredths of length to base of caudal.)

	H. unifasciatus.					*H. roberti.*				*H. rosæ.*	*H. pleii.*				
LOCALITIES.	Key West.	Key West.	Key West.	Key West.	Key West.	Cedar Keys.	Cedar Keys.	Cedar Keys.	Cedar Keys.	San Diego.	Key West.	Key West.	Key West.	Key West.	Key West.
Length of specimen, in inches.	7·45	8 05	7 56	5·45	5 2	5 75	6 1	5·85	5·2	4	8·8	8·4	10·3	11·2	8·55
Head, from tip of upper jaw to gill opening. (Hundredths) . .	21½	21½	22	23	22½	22½	23	23	23½	20	18¼	18½	19½	18½	19
Head, from tip of lower jaw to gill openings. . .	42½	40½	42	43	43½	47	47½	47½	48½	50	43	44½	41½	42	41½
Distance of ventrals from tip of snout. . . .	57	59	57	59	57	57	60	58	59	63	53½	54	54½	52	52½
Distance of dorsal from tip of snout	78	78	77½	78	78	77	79	78	79	76	61½	62	60½	59	60
Length of pectorals. . .	13	13¼	14	14	14	14	14	14	14½	11½	14	14	13½	14	14
Depth of fish at ventrals. . .	14	14½	14	13½	14	13	13	12	13	11½	12	11½	12½	18½	12½
Thickness of fish at ventrals. .	10	11	10½	9	9½	8½	8½	8½	8½	8	6	6	6	6	6
Least depth of caudal peduncle	5½	6	6	6	6	5	5	5	5	4½					
Length of base of dorsal. .	14½	14	14	14	14	14	14	13½	14½	16	11	12	12	11	12
Diameter of eye	5¾	5½	5½	5½	5½	5	5½	5	5½	5	4½	4½	5	4½	4½
Width of interorbital. . . .	6	6	6	6	6	5½	5½	5½	6	6	4½	4½	5	4½	4½
Breadth of head at posterior end of maxillary. .	5½	5¾	5½	5½	5¼	4½	5	5	5½						
Breadth of beak at tip of upper jaw. . . .	3½	3½	3½	3½	3½	3	3	3	3¼						

A REVIEW OF THE AMERICAN SPECIES OF THE GENUS TEUTHIS.

BY SETH E. MEEK AND MARTIN L. HOFFMAN.

In the present paper is given the synonymy of the American species of *Teuthis* L. (= *Acanthurus* Forskål) with an analysis of their most important specific characters.

Specimens of each of three species, which seem to us valid, were obtained by Professor David S. Jordan, at Havana and at Key West. On this material, belonging to the Indiana University and the United States National Museum, the present paper is based. It is possible that other species exist in American waters, but there is certainly nothing in any published description which suggests the probability that such is the case.

We are indebted to Professor Jordan for use of his library and for valuable aid.

Analysis of American Species of Teuthis.

a. Outline rhomboid, the depth 1½ in length to base of caudal; anterior profile subvertical, nearly straight, making an angle of about 60° with axis of body; color brown, washed with bright blue; body marked with undulating longitudinal light streaks; no dark crossbars; vertical fins with oblique bronze streaks; lips and caudal spine yellow; caudal deeply emarginate, its lobes about equal in length; middle rays about ⅝ length of outer rays; head 3¼ in length to base of caudal. D. IX–27; A. III–24. *cœruleus.* 1

aa. Outline ovate; the depth 2 in length to base of caudal; anterior profile moderately convex, making angle of about 45° with axis of body.

b. Caudal deeply emarginate, its upper lobe longer than lower, slender and produced into a filament, the inner rays ⅜ length of the outer rays (in the adult); margin of caudal fin whitish; color dark brown, no transverse bars; brown wavy longitudinal streaks on sides of body; eight dark lines running parallel with edge of dorsal fin for its whole length, and separated by interspaces of the same width; anal fin bluish, with a violet base; head 3½ in length of body. D. IX–24; A. III–22. *tractus.* 2

bb. Caudal simply lunate, its inner rays about ⅗ length outer rays; caudal lobes subequal, the upper never filamentous; color olive-brown, more or less distinctly greenish; middle of sides paler; sides with about twelve distinct blackish vertical bars, rather narrower than the interspaces, most distinct over front of anal; a brownish stripe along base of dorsal; spinous dorsal with alternate stripes running upward and backward, of dark blue and bronze olive, the two colors of about equal width; soft dorsal with a bluish streak on the anterior side of each ray, and a bronze stripe behind it; head 3½ in length of body. D. IX–26; A. III–24. *hepatus.* 3.

1. **Teuthis cœruleus.**

Turdus rhomboidalis (The *Tang*), Catesby, Nat. Hist. Carolina, etc., ii, 1743, pl. 10, fig. 1 (Bahamas).

Teuthis fusca cæruleo nitens Brown, Jamaica, 1756, 454 (Jamaica).

Barbero Parra, Descr. Dif. Piezas, Hist. Nat., 1787, 45, Taf. 21, fig. 2 (Cuba).

Acanthurus cæruleus Bloch & Schneider, Systema Ichthyol., 1801, 214 (after Catesby, Parra & Brown); Cuvier & Valenciennes, Hist. Nat. Poiss., x, 1835, 179 (Martinique; Porto Rico; San Domingo); Günther, Cat. Fish. Brit. Mus., 1861, 336 (Caribbean Sea; West Indies; Bahia); Poey, Syn. Pisc. Cub., 1868, 355 (Cuba); Jordan & Gilbert, Syn. Fish. N. A., 1882, 617.

Acanthurus broussonnetii Desmarest, Prem. Dec. Ichthyol., 1823, 26, pl. 4, fig. 2 (Cuba).

Acanthurus brevis Poey, Memorias, ii, 1860, 207 (Cuba; young); Poey, Syn. Pisc. Cub., 1868, 355 (Cuba); Poey, Enum. Pisc. Cub., 1875, 66 (Cuba).

Acronurus cæruleatus Poey, Enum. Pisc. Cub., 1875, 69 (Cuba; larval form).

Acanthurus nigricans Goode, Bull. U. S. Nat. Mus., 1876, 41 (Bermudas) (probably not of Linnæus, a species of unknown origin, as yet unrecognized).

Habitat.—Atlantic shores of tropical America; Cuba; Key West; Martinique; Porto Rico; San Domingo; Bahia.

The synonymy and nomenclature of this beautiful species seem to be subject to no doubts of importance. It is rather less abundant at Key West or at Havana than either of the other species. One specimen corresponding to *A. brevis* Poey,

was taken at Key West. This is precisely like the adult, but shows very little blue.

The species called *Acronurus* are, as shown by Günther and Lütken, the young of *Teuthis*. The three species mentioned by Poey (*cœruleatus*, *nigriculus*, *carneus*) seem to be the young respectively of three species of *Acanthurus*. One of these, *Acronurus carneus*, was obtained by Prof. Jordan; we regard it as unquestionably the young of *Teuthis hepatus*.

2. **Teuthis tractus.**

Acanthurus tractus Poey, Memorias, ii, 1860, 208 (Cuba); Poey, Rept., 1866, 356 (Cuba); Poey, Syn. Pisc. Cub., 1868, 356 (Cuba); Poey, Anales Soc. Hist. Nat. Madrid, 1880, 246 (Cuba); Poey, Enum. Pisc. Cub., 1875, 67 (Cuba); Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 108 (Mazatlan; no description); Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 111 (Panama; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 377 (Panama; no description); Jordan & Gilbert, Syn. Fish. N. A., 1882, 941.

Acronurus nigriculus Poey, Enum. Pisc. Cub., 1875, 69 (Cuba; larval form).

Acanthurus matoides Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 626 (Panama; no description; not of Cuvier & Valenciennes).

Habitat.—Coasts of tropical America; Cuba; Panama. Key West; Mazatlan; Panama.

This species may at all ages be known by the form of its caudal. Although in all species the caudal lobes grow longer with age, still very young specimens, as well as old of this species have the caudal more deeply furcate than any of *T. hepatus*.

There are also some color differences between the two.

The single species of *Teuthis* found on the Pacific coast of tropical America seems to be identical with *T. tractus*. It is close to *A. matoides* Cuvier & Valenciennes, but Prof. Jordan, who has examined the type of the latter in Paris, thinks it different.

3. **Teuthis hepatus.**

Hepatus mucrone reflexo utrinque prope caudam Gronow, Zoophyl, No. 353.

Teuthis hepatus Linnæus, Syst. Nat., ed. 12, 1766, 507 (not as restricted by Cuvier & Valenciennes; is based principally on *Hepatus* of Gronow).

Acanthurus hepatus Bloch & Schneider, Systema Ichthyol., 1801, 211 (in part; not of Cuv. & Val. and later authors).

Chaodon chirurgus Bloch, Ausl. Fish., 1784, 99, sp. n. 24, taf. 208 (on a drawing by Plumier); Gmelin, Syst. Nat., 1789, 1259 (copied).

Acanthurus chirurgus Bloch & Schneider, Systema Ichth., 1801, 214 (copied); Cuvier & Valenciennes, Hist. Nat. Poiss., x, 1835, 168, (Martinique; Brazil; Cuba); Günther, Cat. Fish. Brit. Mus., iii, 1861, 329 (Bahia; Puerto Cabello; Caribbean Sea; West Indies); Poey, Syn. Pisc. Cub., 1868, 355 (Cuba); Goode, Bull. U. S. Nat. Mus., 1876, 42 (Bermudas); Poey, Anal. Soc. Nat. Hist., Madrid, 1880, 245, pl. 6 (Cuba); Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237 (name only); Jordan & Gilbert, Syn. Fish. N. A., 1882, 617.

Acanthurus phlebotomus Cuvier & Valenciennes, Hist. Nat. Poiss., x, 1835, 176 (Martinique; Brazil; Havana; New York); Dekay, New York Fauna Fish, 1842, 139, pl. 73, fig. 234 (copied); Poey, Repertorio, 1867, i, 256 (Cuba); Poey, Syn. Pisc. Cub., 1868, 245, fig. 7 (Cuba); Poey, Soc. Hist. Madrid, 1880, 245 (Cuba).

Acronurus fuscus Gronow, Cat. Fish., ed. Gray, 1858, 191.

Acanthurus nigricans Jordan & Gilbert, Syn. Fish. N. A., 1882, 941 (copied).

Habitat.— Atlantic Coast of America. Key West; Cuba; West Indies; Puerto Cabello; Martinique; Caribbean Sea; Brazil; Bahia.

This is the most abundant species of the genus, being apparently common throughout the West Indies, and certainly so at Cuba and Key West, and ranging northward occasionally on our South Atlantic Coast, perhaps as far as Charleston, but certainly not to New York, where it is reported on the authority of the confused collection of Milbert.

Two questions arise in the synonymy of this species; first, as to the identity of *phlebotomus* with *chirurgus;* second, as to the availability of the Linnæan name *hepatus* and *nigricans* for it. As to the first point, the description and figure of Cuvier and Valenciennes agree too well with our specimens for us to doubt their identity. Poey recognizes a species, *A. phlebotomus*, as distinct from *A. chirurgus* Poey, but on characters of slight importance and variable with age. The Linnæan name *nigricans* has been used both for this species and for *T. cæruleus.* The name is based on a description of Artedi, which has been considered by Cuvier and Valenciennes as probably belonging to an Asiatic species. The locality of the original specimen is uncertain, and the species cannot be positively made out. No American species should therefore be called *nigricans.*

The name *hepatus* has been used by Cuvier and Valenciennes

for an Asiatic species. The original *Teuthis hepatus* of Linnæus is based on various references, including *cæruleus*, *chirurgus* and the Asiatic species in question. The original type is, however, evidently the *Hepatus mucrone reflexo utrinque prope caudam* of Gronow, and part of the confusion has come from Gronow's attempt to identify with his specimen the Asiatic references of Valentyn and others. Gronow's specimen, however, is the type of his *Hepatus*, and consequently the proper type of *Teuthis hepatus* Linnæus. This same specimen, *Hepatus*, became the *Acronurus fuscus* of Gronow's Systema (Gray), and it is still in the British Museum. Günther identifies it with *Acanthurus chirurgus;* we do not, therefore, see how the substitution of *hepatus* for *chirurgus* is to be avoided, if the rules of nomenclature are strictly carried out. The same line of argument is used by Cuvier and Valenciennes, but they erroneously supposed Gronow's specimen to be an Asiatic fish.

Poey has referred the *Chætodon chirurgus* of Cuvier and Valenciennes to *Acanthurus tractus*, because of this expression in their description: "La caudale échancrée en croissant jusqu'au tiers peu près de sa longueur; ses lobes sont arguisés en pointe et le supérieur est plus long que l'inférieur." This does not indicate the *tractus*, which has the caudal still more deeply divided, and it is true of the average example of *T. hepatus*. *Acronurus carneus* seems to be the young of this species.

A REVIEW OF THE AMERICAN SPECIES OF SCOMBEROMORUS.

BY SETH E. MEEK AND ROBERT G. NEWLAND.

In the present paper we have given the synonymy of the four American species of the genus *Scomberomorus* Lacépède (= *Cybium* Cuvier), and an analytical key, by which the species may be distinguished.

The specimens upon which the paper is based, belong to the Museum of the Indiana University. They have been collected by Professor Jordan at Key West, Havana, and Monterey.

We acknowledge our indebtedness to Professor Jordan for the use of his library and for valuable aid.

Analysis of the American Species of Scomberomorus.

a. Dorsal spines 17 or 18; lateral line descending obliquely; gill rakers comparatively long, more than half diameter of eye.

b. Teeth slender, subconical, their length more than twice their width at base; gill rakers long and slender, about $\frac{3}{5}$ diameter of eye, about 18 below the angle; maxillary reaching to opposite posterior margin of eye. Color of male dark steel-blue, without streaks or spots; female with two rows of alternating round bronze spots of about the size of pupil; fins nearly plain, dark; head $5\frac{1}{4}$ in length; depth $5\frac{3}{4}$. D. XVII–16–VIII; A. I–16–VIII. *concolor*. 1.

bb. Teeth large, triangular, compressed, their length not twice their breadth at base; gill rakers rather slender, their length about $\frac{3}{5}$ diameter of eye; about 12 below the angle.

c. Color bluish silvery above, with bright reflections; sides in both sexes, with numerous bronze spots about as large as pupil, no longitudinal stripes; maxillary reaching to opposite posterior part of orbit; angle of preopercle not produced backwards; pectoral scaly at base only; caudal peduncle rather robust, its least depth $4\frac{2}{3}$ in head, caudal widely forked; head $4\frac{3}{4}$ in length; depth $5\frac{1}{2}$. D. XVIII–18–IX; A. II–17–VIII. *maculatus*. 2.

cc. Color silvery; sides with a brownish, broken, longitudinal band, above and below which are numerous brownish spots; angle of preopercle produced backwards; pectorals scaly; anterior part of spinous dorsal black; caudal peduncle rather slender, its least depth $5\frac{1}{2}$ in head; caudal less widely forked; head $4\frac{1}{2}$ in length; depth $5\frac{1}{2}$. D. XVIII–15–VIII; A. II–15–VIII. *regalis.* 3

aa. Dorsal spines 14 or 15, lateral line descending abruptly under second dorsal; teeth comparatively large; gill rakers very short, less than $\frac{1}{3}$ diameter of eye, about 8 below the angle; pectorals scaly at base only; young, with bronze spots; adult immaculate. *cavalla.* 4.

1. **Scomberomorus concolor.** Monterey Mackerel.

Chriomitra concolor Lockington, Proc. Acad. Nat. Sci. Phila., 1879, 134 (Monterey); Lockington, Rep. Cal. Fish Comm. (1878–9), 1881, 34 (Monterey).

Scomberomorus concolor Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Monterey, no description); Jordan and Jouy, Proc. U. S. Nat. Mus., 4, 1881, 13 (Soquel, Cal., no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 45 (Monterey Bay); Jordan and Gilbert, Syn. Fish. N. A., 1882, 426.

Habitat.—Pacific Coast of United States; Monterey Bay, all the known specimens having been taken about Soquel and Santa Cruz, whither it resorts every summer for a short time, for the purpose of spawning. Some 15 to 40 specimens only are taken each year.

2. **Scomberomorus maculatus.** Spanish Mackerel.

Scomber maculatus Mitchill, Trans. Lit. and Phil. Soc., i, 1815, 426, pl. 6, f. 8 (New York).

Cybium maculatum Cuvier, Règ. Anim., ed. 2, 1829 (after Mitchill); Agassiz, Spix. Pisc. Brazil, 1829, p. 103, tab. 60 (Atlantic); Cuvier and Valenciennes, Hist. Nat. Poiss., viii, 1831, 181 (New York); Storer, Bost. Jour., iv, 1842, 179 (Lynn, Mass.); Ayres, Bost. Jour. Nat. Hist., iv, 1842, 261 (Brookhaven); De Kay, N. Y. Fauna, Fish, 1842, 108, pl. 73, f. 232 (Long Island); Storer, Synopsis, 1846, 92; Baird, Fish N. J. Coast, 1855, 21 (Beaseley's Point); Günther, Cat. Fish. Brit. Mus., ii, 1860, 372; Storer, Hist. Fish. Mass., 1867, 68, pl. 13, f. 1 (Lynn, Mass.; Provincetown); Gill, Rept. U. S. Fish Comm., 1871–72, 802 (name only); Baird, Rept. U. S. Fish Comm., 1871–72, 825 (Wood's Holl), no description; Gill, Cat. Fish. E.

Coast N. A., 1873, 24 (name only); Poey, Proc. U. S. Nat. Mus., 1878, 4 (after Cuvier and Valenciennes); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1878, 375 (Albemarle Sound); Goode, Proc. U. S. Nat. Mus., 1879, 3 (East, Florida), no description; Goode and Bean, Proc. U. S. Nat. Mus., 1879, 128 (Pensacola); Goode and Bean, Fish. Essex Co., Mass., 1879, 15 (no description); Bean, Proc. U. S. Nat. Mus., 1880, 89 (Washington Market), no description.

Scomberomorus maculatus Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 106 (Mazatlan, no description); Jordan and Gilbert, Bull. U. S. Fish Comm., 1882, 110 (Panama, no description); Jordan and Gilbert, Syn. Fish. N. A., 1882, 426; Goode and Bean, Proc. U. S. Nat. Mus., 1882, 237 (Gulf of Mexico, no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 268 (Pensacola, no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 594 (Charleston, no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 625 (Panama, no description); Bean, Cat Fish. Exhibition, London, 1883, 51 (Charlotte Harbor, Fla., no description).

Habitat.—Both coasts of America; from Lynn, Mass., to Key West; Mazatlan; Panama. Not recorded from Cuba or any of the lesser Antilles.

3. **Scomberomorus regalis.** Pintado.

Scomber regalis Bloch, Ausl. Fische, 1795, Taf. 335 (after a drawing by Plumier); Bloch and Schneider, Systema. Nat., 1801, 22 (after Bloch).

Cybium regale Cuvier, Règne Animal, ed. ii, 1829 (name only; after Bloch); Cuvier and Valenciennes, Hist. Nat. Poiss., viii, 1831, 184 (San Domingo); Poey, Syn. Pisc. Cub., ii, 1868, 326 (Cuba); Gill, Rept. U. S. Fish Comm., 1871–72, 802 (name only); Baird, Rept. U. S. Fish Comm., 1871–72, 825 (Wood's Holl; no description); Gill, Cat. Fish East Coast N. A., 1873, 24 (name only); Poey, Proc. U. S. Nat. Mus., 1878, 4 (Cuba); Goode, Proc. U. S. Nat. Mus., 1879, 3 (East Florida, no description).

Scomberomorus regalis Goode and Bean, Proc. U. S. Nat. Mus., 1882, 237; Jordan and Gilbert, Syn. Fish. N. A., 1882, 426.

Scomberomorus plumieri, Lacépède, iii, 1801, 292 (after Aubriet's copy of Plumier's drawing).

Cybium acervum Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 186 (in part; type); Poey, Repertorio, i, 1867, 322; ii, 13 (Cuba); Poey, Proc. U. S. Nat. Mus., 1878, 4 (no description).

Habitat.—Atlantic Coast of America; Wood's Holl, Mass.; Key West; Cuba; San Domingo. More abundant southward; rare north of Key West.

4. **Scomberomorus cavalla.**

Guarapucu Marcgrave, Hist. Brasil. 1648, 178 (Brazil).

Cybium cavalla Cuvier, Règne Animal, 1829, ed. 2d (after Marcgrave).

Cybium caballa Cuvier & Valenciennes, Hist. Nat. Poiss., viii, 1831, 187 (Brazil); Günther, Cat. Fish. Brit. Mus., 1860, 373 (San Domingo); Poey, Report, i, 1867, 322; ii, 13 (Cuba); Guichenot, Sagra, Hist. Cuba Poiss., 1850, 103 (Cuba); Poey, Proc. U. S. Nat. Mus., 1879, 3 (East Florida; no description); Poey, Bull. U. S. Fish Comm.. 1882, 118 (no description).

Scomberomorus caballa Goode & Bean, Proc. U. S. Nat. Mus., 1882, 237 (no description); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 268 (Pensacola); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 549 (Charleston; no description); Jordan and Gilbert, Syn. Fish., 1882, 427 (copied).

Habitat.—Atlantic Coast of America; Charleston; Brazil. A food fish of great importance in the West Indies and Southern Florida. It reaches a much larger size than any other.

The name *cavalla*, first used by Cuvier, has priority over *caballa*.

OCTOBER 7.

MR. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-three persons present.

A paper entitled "The Geology of Delaware—Laurentian, Palæozoic and Cretaceous Areas," by Frederick D. Chester, was presented for publication.

The death of Geo. Bentham, a correspondent, was announced.

OCTOBER 14.

The President, DR. LEIDY, in the chair.

Twenty-five persons present.

The death of Charles W. Poultney, a member, was announced.

The following were ordered to be printed:—

PRELIMINARY NOTES ON THE GEOLOGY OF DELAWARE—LAURENTIAN, PALÆOZOIC AND CRETACEOUS AREAS.

BY FREDERICK D. CHESTER.

INTRODUCTION.

During the years 1837 and 1838, Professor James C. Booth, in accordance with an act of the State Legislature, made a geological survey of Delaware, the results of which were published in a report that appeared in 1841. This old memoir is of great value, both from the accuracy of the author's observations and his minute attention to detail; I cannot, therefore, expect to supplant it, my aim being an entirely different one, *i. e.*, to so completely reconstruct our geology as to bring it into sympathy with the results of adjacent States. Professor Booth's great and only fault as a geologist lay in his entire indifference to stratigraphical order; and his classification of deposits according to mineralogical and physical characters, leaves one in utter confusion.

My main object, therefore, is to endeavor to undo the tangles which Professor Booth has unconsciously made, by stating the facts in the briefest and clearest manner possible.

The results, as embodied in the following paper, are preliminary to what is hoped will be a full report upon the State.

GEOLOGICAL OUTLINE.

The formations represented within the bounds of the State are Laurentian (?), Cambro-Silurian, Silurian-Devonian (?), Cretaceous, Tertiary and Quarternary. The relations and positions of the several divisions of the chronological scale can be best represented by the accompanying table (I), also the thickness of each formation. Column 2, with which the Delaware series is compared, is constructed according to what seem the best results, combining home and foreign equivalents. The accompanying map (Pl. V) is drawn upon a scale of four miles to the inch, and is sufficiently large to show all necessary details. A word is here necessary in regard to the boundaries as shown by the map. The lenticular areas which indicate the magnesian marble, can only serve to represent the position of outcrops. Owing to the fact that these calcareous deposits are entirely covered by the micaceous rocks, surface indications offer no means of determining the entire area covered by the former.

I.

Periods.	General Series.	Delaware Series.
Quarternary.	Modern.	Bog Clay or Alluvium.
	Post-Glacial. Glacial.	Delaware Gravels and Estuary Sands—10–40′.
Tertiary.	Pliocene. . .	Blue Clay—3–10′. Glass Sand.—40′.
	Miocene. . . .	White, Potters' Clay—10–20′.
	Eocene.	
Cretaceous.	Upper.	Middle Marl—139′.
		Indurated Marl—149′.
		Lower Marl Bed—60′.
	Middle.	Sand Marl—90′.
	Lower. (Wealden.)	Plastic Clays—250′.
		Mica Schists and Gneisses.
Cambro-Silurian.	Calciferous. Potsdam.	Magnesian Marbles. Quartzite.
Laurentian (?)	Laurentian (?)	Syenitic Rocks.

Owing also to the fewness of the outcrops of the several divisions of the Cretaceous, the boundaries had to be drawn from such data as were accessible, which were in some cases abundant, and in others entirely absent. Sufficient is known, however, to make the writer confident of their general accuracy; while the missing links of knowledge could only be supplied by expensive borings.

The Laurentian.—To this belongs the belt of hornblendic rocks above the line of the Pennsylvania R. R., which to the west is narrow but which rapidly broadens to the east, as it extends into Delaware county, Pa., and contracting again to a narrow neck at Chester Creek, there connects with another irregular area occupying all the northwestern portion of Delaware county. This area connects with still another to the north, and to the east of West Chester. This rock is a dark hornblendic gneiss or amphibolite schist, dipping usually to the northwest, rarely in the opposite direction. With it is associated a grayish to bluish gray rock, usually finely crystalline, which has been designated as diorite and syenitic granite by the Pennsylvania geologists. Owing to the absence of petrographical facts concerning this rock, however, nothing definite can be said concerning it. It shades by indistinct degrees into the amphibolite schists, the two varieties probably forming the same eruptive series.

The Cambro-Silurian.—This formation, so largely developed through the counties of southeastern Pennsylvania, has one area in the northwestern part of Delaware, and two smaller exposures. In the northwestern area, a coarse quartzitic rock is found to underlie a highly crystalline magnesian marble. These, as we shall more clearly perceive further on, must be referred respectively to the Potsdam and Calciferous, the latter of which is equivalent to the Lower Magnesian limestone of the West.

The Mica Schists and Gneisses.—To the north of the belt of Laurentian gneisses, and resting upon the latter, is a series of mica schists and granitic gneisses, with which are associated bedded granites, serpentine, and hornblende rocks. They have commonly been referred to the *Mont-Alban*, which, together with the older hornblendic rocks, were called *Azoic*, the two forming a part of the southern gneiss area as known by the Pennsylvania geologists. It will be my aim, shortly, to show that the hornblendic rocks and mica schists do not make two successive formations, within the Azoic, but that, while the former is either Laurentian or Huronian, the latter must be placed above the Trenton, and possibly above the Hudson River, slates. Their exact position in the Palæozoic scale, however, will probably never be determined, owing to the complete absence of fossiliferous remains, due to the extreme metamorphism. The rocks have been subjected to great contortion, the strata having been

pressed either into close folds, or into broad or contracted anticlinal or synclinal flexures.

The Cretaceous.—Resting upon the eroded edge of the Azoic rocks are successive series of plastic clays, sand marls and green-sand, which form quite uniform strata, dipping at a low angle to the southeast. This belt, having a width of 18 miles, extends from the hills to the latitude of Noxontown mill pond, just south of Middletown.

The Tertiary.—The Cretaceous is succeeded by a stratum of white or lead-colored clay, having a thickness of 10 to 20 feet. This continues as far south as Murderkill Creek, and from fossiliferous evidence, must be referred to the Miocene.

South of Murderkill Creek, the Miocene is succeeded by 3 to 10 feet of light or dark blue clay, beneath which is a uniform stratum of fine glass sand, of at least 40 feet in thickness. That all the State south of Murderkill is later Pliocene, I shall endeavor to prove in a future paper upon the younger formation.

All the beds of the Tertiary lie in a nearly horizontal position, dipping at a still lower angle than the Cretaceous, and probably unconformable to the same.

The Quarternary.—Covering most of the foregoing formations, and reaching up the flanks of the Azoic hills to the height of 200 feet or more above tide, is a layer of sand and gravel, which to the north is of a coarse, red nature, and to the south is fine and white. They are called the Delaware Gravels and Estuary Sands, respectively. Along the river and bay shores is also the belt of bog-clay, which is modern, and of more recent origin than the gravels. Also upon the summits of the highest hills in the State are solitary patches of gravel which are evidently older than the continuous stratum to the south. This high-level gravel, in the absence of proper data, has been problematically referred to the Tertiary, and is known as *Bryn Mawr* gravel.

The Crystalline Rocks.

Geographical Position.—Generally speaking, the southern line of the Azoic rocks is the limit of the highlands, but in certain places they extend well into more level regions. Beginning with a point upon the Maryland boundary, a little north of where the latter is cut by the Mason and Dixon line, the limit of the rocks runs in a northeast direction, cutting through the western end of Newark, and following the northern boundary of the town.

Thence it runs close to the south shore of White Clay Creek to a distance of two miles beyond Roseville, where it makes an abrupt bend to the north, until at Stanton the rocks cease to be found. A mile back of the railroad station, they again appear, continuing to a point about a mile back of Newport, where their course turns slightly to the southeast, crossing the Wilmington turnpike just before it is intersected by the Wilmington Northern R. R., thence it follows the turnpike through the southern half of the city, keeping just north of the Pennsylvania R. R., to a point south of Bellevue, where the line cuts the river. From there the Delaware River marks the southern boundary. The area as above indicated may be divided into two pretty distinct belts: (1) the southern belt of hornblendic rocks, and (2) the northern belt of micaceous rocks, with which are associated interstratified beds of coarse-grained orthoclase granite, feldspar, quartz and quartzite.

The boundary line between these two belts can be traced very accurately, and is found to correspond pretty closely with the lines of strike. Beginning with the western boundary of the State, the line follows approximately the course previously traced out, but one-half a mile to the north of the same. It continues thus to a point south of Milltown, when an abrupt turn to the northeast is taken, the line crossing the Brandywine only a few miles from the head of the State. It is owing to the northerly course of this line, as compared with the southern limit of the Azoic area, that the northeastern portion of the State is covered more largely with the hornblende, and the northwestern with the micaceous rocks.

The Lithology of the Crystalline Rocks.

The rocks which cover the crystalline area may be classed as follows:—

Micaceous $\left\{\begin{array}{l}\text{Granite,}\\\text{Granitic gneiss,}\\\text{Mica schist.}\end{array}\right.$

Hornblendic $\left\{\begin{array}{l}\text{Amphibolite schist,}\\\text{Blue to gray trap.}\end{array}\right.$

Calcareous $\left\{\begin{array}{l}\text{Marble,}\\\text{Saccharoidal limestone.}\end{array}\right.$

Serpentine.
Quartzite.
Vitreous quartz.

Granite.—This rock, as known in the State, is divided into two classes: (1) that which forms intrusive beds, being a coarsely crystalline orthoclase granite, and (2) that which is nothing more than a highly metamorphosed granitic gneiss, or mica schist, it being a very compact, fine-grained rock. The former variety may be described as an intimate mixture of flesh-colored orthoclase, quartz and muscovite mica, with which are often associated albite and biotite. It occurs as veins, usually bedded, which vary in width from 6 inches to 25 feet, and which, though often continuing in length for several miles, are known to pinch out entirely. The great difference in lithological character between the enclosing rocks and these beds would imply that the latter are veins of plastic injection from aqueo-igneous fusion. That the intrusion of the semi-molten magma was subsequent to the uplifting and crystallizing of the enclosing rocks, is proven by the fact that the latter have, in the vicinity of such veins, suffered considerable disturbance and undue metamorphism at the planes of contact with the intruded mass. The granite is often so highly feldspathic as to be worked exclusively for this mineral, and when the upper portions of such veins are greatly decomposed, diggings have in a few cases been made for kaolin.

One of the most noticeable of these veins of coarse granite is found to cut across the road leading up the Brandywine, about one and a half miles from the head of the State. A large quarry has been opened in this vicinity, where the rock has been worked for feldspar. The vein is not less than 20 feet wide, on the one side of which is a highly metamorphosed mica schist, and on the other hornblendic gneiss. The rock is a mixture of red orthoclase, albite, blue quartz, and muscovite, the crystals being sometimes so large that perfect specimens of feldspar several inches square, can be obtained. Large hexagonal plates of mica, many of them 6 inches across, are also found in abundance. The same feldspar is worked three miles to the northeast, probably from the same vein, as near as could be determined; while in the other direction the intrusive mass seems to lose itself.

Another equally wide vein cuts across the Newark and Avondale R. R., at Tweed's mill, two miles north of Newark. A faulting plane cuts through this intrusive bed, possibly due to its disturbing action.

The same rock is found to continue two miles and a half to the

northeast, outcropping upon the run to the south of Pleasant Hill P. O. Many other instances of granite veins might be cited, but with nothing new regarding them. All of the large veins mentioned above are exclusive of the smaller seams, which vary in width from a few inches to a foot, and which are liable to be found anywhere, and frequently, within the micaceous belt.

The second class of granite—a highly changed gneiss or schist—is a fine-grained rock containing quartz, plagioclase and biotite, with the quartz subject to considerable variation.

It occurs as massive beds, the planes of the stratification being so completely obliterated that the rock resembles a true trap. That it is not trappean, however, is shown by the fact that it is seen to run, by indistinct degrees, into mica schist. Such rocks are usually much broken up, thus testifying to an undue mechanical activity, itself the cause of the extreme metamorphism.

Granitic Gneiss and Mica Schist.—These two species represent the extremes of variation in what is the characteristic rock of the micaceous belt, which has gone by the generally applicable name of gneiss. These two rocks so merge into each other that specific designation is often difficult. The typical mica schist may be described as a very schistose biotite rock, usually highly garnetiferous, and containing a variable proportion of quartz. Sometimes this highly micaceous rock contains a very small proportion of feldspar, which can often only be seen as a kaoline substance in the decomposed product; and if the absence of feldspar be characteristic of mica schist, then with the presence of feldspar the true schists begin to run into gneiss.

Hornblende Rocks.—The hornblende rocks, as a class, may be divided into the basic and acidic, or into those rocks of which the predominating constituent is either hornblende or feldspar. To the former belong the dark varieties of amphibolite schist and syenitic gneiss, and to the latter belongs the light, highly acidic bluish gray trap so characteristic of the northeastern part of the State. Between these two extremes there is every shade of gradation, showing some petrographical relation between them. The dark varieties of amphibolite schist vary in color from a blue to a dull black, from coarsely crystalline to compact. The predominating element is hornblende, with which is associated a small proportion of plagioclase, and sometimes blue quartz. This rock, which shows a more or less eminent lamination, is found

to merge into a massive rock of the same composition. When the proportion of hornblende increases, it becomes so great as to make up, apparently, the entire composition, in which case the syenitic gneiss runs into the hornblende schist or into massive hornblende rock. The bluish gray trap may be described as follows: in color it varies from a light to a dark bluish gray; in texture, from a coarsely crystalline to one fine-grained, homogeneous and trappean in character.

Lithologically, the rock is composed of plagioclase, feldspar and hornblende, with frequently a small proportion of blue quartz and biotite.

Massive hypersthene has often been found in fine orthorhombic crystals, entirely replacing the hornblende, and is associated with a plagioclase showing the most eminent striation. Thus, from microscopical examination, the rock seems to range from a *quartz diorite* to a true *hyperite*, although no true knowledge of the rock can be had until a thorough microscopical study is made. Professor G. H. Williams,[1] of Johns Hopkins University, has proven a similar rock, in the vicinity of Baltimore, to be a *hypersthene gabbro*, which also runs by indistinct stages into a true *amphibolite schist*. He has also shown that the *amphibolite* is the result of a paragenesis taking place in the *gabbro*, the hypersthene and pyroxene found in the latter being altered to hornblende, and thus producing the gradual passage of gabbro into amphibolite. Whether some such alteration as this can account for the passage of the bluish gray trap into amphibolite schist is quite within the range of possibility. This question has already become a subject of investigation by the writer, and it is hoped that much light will be thrown upon it.

Calcareous Rocks.—To this class belong those rocks generally called crystalline limestone, of which there are two varieties, namely, saccharoidal limestone and marble. They are found at three known localities, one near Pleasant Hill, one at Hockessin and another near Centreville, both varieties occurring together.

The marble may be described as very coarsely crystalline. It is very compact in texture, of superior hardness, and is always heavily and closely bedded. The variety called saccharoidal limestone is more granular and extremely friable. It is also

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[1] Am. Jour. of Sci., October, 1884, and Johns Hopkins Univ. Circular, April, 1884.

less pure, being often colored by oxide of iron or organic matter, and is much more thinly bedded, the thinner seams being interstratified with the heavily bedded marble.

Serpentine.—About six miles northeast of Wilmington a huge dike of serpentine runs with the micaceous schists. Its length can be traced by outcropping boulders for a distance of a mile, with a width of a quarter of a mile. The rock varies from one tough and massive to one soft and highly decomposed, with which are associated talc and magnesite.

Vitreous Quartz and Quartzite.—The former rock occurs as regular thin or massive seams interstratified with the micaceous rocks. It varies from a glassy colorless variety to one of milky and opaque whiteness. The quartzite, which is found in the northwest corner of the State, underlying the limestone, is probably of Potsdam age. It is a very coarse quartzite rock, which contains, frequently, crystals of *tourmaline*, *fibrolite* and *actinolite.*

Structural Relations of the Crystalline Rocks.

Strike and Dip.—The rocks of this formation, except in a very few cases, are all stratified with variations of bedding, from that as thin as slate in the mica schists to that so heavy as to resemble massive trap intrusions. Both strike and dip are subject to great variation. A dip to the southeast for a long distance, with an opposite dip along a section only two miles and a half to the northeast, can be accounted for only by supposing an unequal thrust from the direction of the contorting force. In fact, out of five different sections made across the Azoic belt at various points of its length, no two showed the same arrangement of strata—from which we conclude that the thrusting force must have acted very unequally along the entire length of the belt, sometimes merely tilting the strata; again, standing them on edge, and yet again, completely overturning them; in some places pressing them into close folds for a part or the entire length of the section, in others leaving gentle or abrupt anticlinal and synclinal folds.

Both strike and dip are also found to be subject to variations from the disturbing action of granitic intrusions. At Dixon's spar quarry the change is from N. 55° E. to N. 22° E. At Pleasant Hill a granitic vein cuts through the limestone, which causes a

disturbance from N. 55° E. to N. 10° E. Excluding cases of local distortion, however, the crystalline rocks range in strike between N. 45° E. to N. 60° E., and in dip from nearly vertical to nearly horizontal.

Dikes.—We have already spoken of the granite and serpentine as intrusive, forming in certain cases true beds, and again, showing genuine vein structure with numerous branchings. Regarding the structural relations of the bluish gray trap, there are as yet some doubts. The geologists of the Second Pennsylvania Survey have spoken of it as forming massive trap intrusions between hornblende gneiss—of which the latter is metamorphic.

This theory, I am inclined to think, will prove to be a mistaken one. In Delaware, as we have said, the gray acided rock runs by indistinct gradations into true amphibolite schist, the many stages of variations being sometimes witnessed in a single quarry, without the slightest structural distinctions. Seams of the gray trap have been seen running through the black hornblende gneiss, but without the least signs of intrusion. That the bluish gray trap may occupy irregular patches more or less lenticular, is no doubt true, but the latter can in no sense be regarded as forming dikes between a metamorphic schist; on the other hand, all the rocks of the hornblendic belt, from the most acidic gray trap to the true amphibolite schist, belong to a single series of eruptive rocks, having wide lithological variations. That these variations may be the result of a subsequent paramorphosis taking place in the bluish gray trap is quite possible; it is therefore to be hoped that present petrographical studies of the hornblendic rocks of the State will throw more light on this important question.

Contortion of Strata.—The crystalline rocks offer the most complicated and striking examples of contortion, presenting nothing, however, which is not characteristic of all metamorphic areas. Close folding is the form generally seen, the line of bedding being either straight, gently or violently contorted. Abrupt anticlinal and synclinal folding is also common, these complex folds being, however, very irregular and much twisted.

Age and Stratigraphical Order.—The crystalline rocks may be divided into four groups, which have a fixed stratigraphical relation to each other, namely, the hornblendic, the micaceous, the calcareous and the quartzitic.

The normal order of arrangement of these strata, and thereby

their relative age, is a point upon which there has been much difference of opinion, owing to the confusing arrangement of the strata throughout some of the counties of southeastern Pennsylvania. Notwithstanding such difficulties, the geologists who have discarded broad generalizations, and devoted themselves to the study of local details, find the way gradually opening to a better understanding of the truth; and the early presumption that the mica schists and gneisses are of Palæozoic age, is rapidly becoming a matter of general acceptation. The latest results of geological study in Pennsylvania, together with the observations of the writer throughout Northern Delaware, tend to show quite conclusively that the crystalline rocks represent the following ages: (1) The Laurentian (?) including the rocks of the hornblendic belt; (2) the Potsdam, to which the quartzitic and sand rocks belong; (3) the Calciferous, including the magnesian marbles, and (4) the age of the mica schists, which must be placed somewhere above the Trenton, and, according to Mr. Charles E. Hall, above the Hudson River, slates. With these points in view, we shall proceed with the demonstration.

The Laurentian (?)—The so-called Laurentian area of Delaware is but a continuation of identical areas in southeastern Pennsylvania, within the Philadelphia belt, which, according to Mr. Hall, are three in number, each connected with the other by a narrow neck, and each situated successively to the northeast. The southernmost of these areas is of lenticular shape, reaching from Chester Creek, and spreading out over the southern part of Delaware County, whence it extends into the State of Delaware, as shown upon the map. Northeast of this patch, and to the northwest of Media, is another area of irregular form, while a third—a long east and west belt—runs from West Chester, south of Conshohocken, eastward to the Delaware River, near Trenton. Thus the Delaware Laurentian forms the southernmost tongue of the one Laurentian area of the Philadelphia belt, the upper portion of which has been for a long time known as the *Third Belt* of Rogers. As regards the age of the *Third Belt*, Mr. Hall says, "The rocks of the *Third Belt* are identical with the granitoid and syenitic rocks of the Welsh Mountain, north of the Chester County limestone valley. These rocks of the Welsh Mountain are similar in all respects to the crystalline rocks extending into

Pennsylvania from New Jersey. In New Jersey they are identified as belonging to the Laurentian."

With these points in view, I have followed Mr. Hall, and placed the syenitic rocks of Delaware in the Laurentian, although I feel that it is, at best, but a problematical designation. Any positive declaration upon this point would be premature, until a more thorough structural and petrographical study has been finished, together with a comparison of results from diverse localities. Throughout southeastern Pennsylvania the hornblendic rocks are always stratigraphically the lowest, and such is the case in northern Delaware.

The general dip of the syenitic rocks, upon the flanks of which rest the strata of the micaceous belt, is, in the latter locality, to the northwest. In the western part of the State, however, the hornblendic rocks have experienced an overthrow, whereby they dip to the southeast, in which case the hornblendic rocks are apparently the younger. This peculiarity need not, however, be misleading as to true stratigraphical order. Putting aside all questions of position of strata, one must note the decidedly primitive aspect of these rocks, which, in lithological characters, are identical with the rocks of more northern portions of the Laurentian area.

The Potsdam.—In the northwestern part of Mill Creek Hundred, a triangular area of Potsdam sandstone is seen upon the map, which, rising from beneath a patch of Bryn Mawr gravel, extends into Pennsylvania, and is best exposed beyond the State line. At Nivin's limestone quarry, a mass of quartzite forms what is clearly an anticlinal fold, over which is a corresponding anticlinal of magnesian limestone. The anticlinal structure of the quartzite is further shown at a few other points, where dips both to the northwest and southeast are noted.

The Calciferous.—Mr. Hall divided the limestone of southeastern Pennsylvania into two groups, namely, the Calciferous magnesia limestones and marbles, and the possible Trenton limestones and slates, the former comprising the rocks of the Chester County limestone valley, and several outlying troughs to the south, the latter those alternations of slate and limestone which form the outer border of the Calciferous belt.

The limestone areas of Delaware belong to the lower of the above groups, or to the Calciferous of Mr. Hall, the equivalent of

the Lower Magnesian limestone of the West. The magnesian marble which outcrops beyond the State line, at Nivin's, runs into Delaware, and appears at the surface in the Jackson quarry at Hockessin. Here the rock forms a clearly defined anticlinal fold. The bending, both to the northwest and southeast, being observed within the cutting. The limestone is overlaid by the mica schists which, to the north of the pit, dip to the northwest, and to the south, southeast, forming an anticlinal fold capping the limestone.

To the southeast of Centreville, the limestone occupies the same stratigraphical position as in the case just mentioned. At Pleasant Hill the bending of the schists over a saddle of limestone is beautifully shown in the quarry cutting, furnishing clear proof as to the superior position of the mica schists.

The Mica Schist and Gneiss.—The inference that these rocks were primal, was based largely upon their lithological similarity to many of the older crystalline schists. They were hence referred to the White Mountain, or the Rocky Mountain, series. But lithological similarities must invariably bend to higher statigraphical evidence. In Delaware the micaceous rocks overlie the limestone, and no readjustment of position can make the arrangement otherwise. They are, therefore, younger than the limestone, which, in its turn, is younger than the underlying Potsdam.

The Calciferous limestone can hardly be referred to any other position, and, invariably underlying the schists, the latter must begin somewhere in the Silurian, and, possibly, mount as high up as the Devonian.

The Cretaceous.

Geographical Extent.—The Cretaceous of Delaware, a continuation of the same formation as developed in New Jersey, extends across the State as a northeast and southwest belt, with a breadth of 18, and a length of from 15 to 20 miles, covering a total area of about 250 square miles. The northern limit of the belt, laid down on the map, has already been traced out as marking the southern boundary of the Laurentian. The southern limit runs a little to the south of, and parallel with, Appoquinimink Creek, cutting through the centre of Noxontown mill-pond, and thence proceeds in a straight southeasterly direction.

Subdivisions.—The formation may be divided into a number of subdivisions, based upon lithological grounds, the period of sedimentation extending through the whole Cretaceous; *i. e.*,

Lower, Middle and Upper, of the English geologists. The divisions can be best represented by the following table, which is also

II.

Upper Cretaceous (Chalk).	Middle Marl Bed.	Yellow Sand.
		Shell Layer.
		Pure Green Sand.
	Indurated Marl Bed.	Indurated Marl.
		Red Sand.
	Lower Marl Bed.	Black Argillo-Micaceous Marl.
		Shell Marl.
		Cretoidal Marl.
Middle Cretaceous (Upper Green Sand, Gault).	Sand Marl.	Sand and Clay Marls.
Lower Cretaceous (Wealden ?).	Plastic Clays.	Red Clay.
		Fire-Clays and Sands.

constructed with a view of showing the relative thickness of each of the groups. In the classification the plastic clays have been placed in the Lower Cretaceous, and are probably the exact equivalent of the Wealden, while the marl deposits, ranging from the Lower to the Middle Beds, can, upon palæontological grounds, be referred with considerable confidence to the Upper Cretaceous, or Chalk. The Sand Marl formation can at best be placed in but an intermediate position, but is probably nearly akin to the marls, all of the fossils ever found within the sand marls of New Jersey having been the characteristic species of the marl beds proper.

Structure.—The different subdivisions of the Cretaceous form uniform beds, dipping at a low angle to the southeast. Having been successively deposited upon a gently sloping bed, they have remained in the same position, with no subsequent disturbance. The general direction of *strike* can be seen from the trend of the various belts. A line joining the point of contact between the Cretaceous, at Newark, with a similar point back of Newport, upon nearly the same level, ran N. 72° E., which course, being approximately parallel with the lines of the lower belts, may fairly represent the strike of the formation. The *dip* was determined with great accuracy at Summit Bridge, about midway of the width of the Cretaceous. At this place the canal excavation has reached a depth of 70 feet, and continues several miles to the westward, with gradually lowering banks. Upon both sides of this wide cutting, the marl outcrops as a well-defined layer, and as any number of lines in the direction of the dip can be obtained, the amount of pitch can be accurately determined. As the transit could always be placed upon either bank in front of the escarpment of marl, and the other side could be easily seen, the operation of determining the difference in level between the two outcrops, on a line running S. 30° E., was not difficult. This difference in level, combined with the angle of depression, as determined by the vernier, would give the data for ascertaining the distance between the outcrops, the latter of which varied from 300 to 400 feet. The results of the observations give a dip of 45 feet to the mile.

Plastic Clays.

This formation is the thickest member of the Cretaceous. Its southern line begins a few miles south of New Castle, and extends

in a southeasterly direction to just below Red Lion, crossing the railroad between Porter's and Kirkwood, and cutting the State line two miles north of Chesapeake City. Although of so much importance, it is, owing to the great thickness of the overlying gravels, rarely exposed, and even when more favorable opportunities are offered, but a few feet of the characteristic Red Clay appear above the surface. The formation is divided into the uppermost Red Clays, and the lowermost White Clays, of which the former is the deposit commonly exposed.

Red Clay.—This is a highly plastic clay, of a vermilion-red color, remarkably free from grit, and cutting with great smoothness. It is identical with the red terra-cotta clays of Perth Amboy, N. J., and may prove to be their equal in quality. The Red Clay forms uniform beds, with which are sometimes interstratified thin seams of fire-clay, making a total thickness of at least 50 feet. *White Clays.*—The series of white clays and sands lying beneath the stratum of red, reach to a great depth below the surface, and have not yet been wholly penetrated by the deepest boring made. The outcrop is upon the lowest ground, of which the only locality discovered lay a little to the south of New Castle, on the river shore. Here the white clay outcrops for a depth of from 10 to 15 feet, giving the following section:

1. Sandy fire-clay, ... 3 feet.
2. Mottled clay, ... 3 feet.
3. A very pure fat fire-clay at water-level.

The lowermost clay of this section is of an unusually fine quality, and has in past years been worked below water-level, and shipped to Trenton potteries. From this exposure we are enabled to see that the White Clay series, outcropping as it does at water-level, covered by a red stratum, and again by some 30 feet of gravel, is entirely out of the reach of study; yet the presumption that it does lie deeply buried is beyond controversy. Our only means of studying the White Clay series is by means of borings, which are very rare, and in no cases have accurate records of the deposits passed through been preserved. We only know that the borings yielded alternate layers of white clays and sands to a depth of 200 feet. We therefore judge that this series presents strong analogies to the white clays of New Jersey.

SAND MARL.

The belt of sand marl runs from the river course to the south of New Castle, gradually tapering in breadth as the Maryland boundary line is reached. The southern limit of the belt, starting at Delaware City, cuts the north corner of St. George's, and keeps about a mile above the canal for the remaining distance across the State. It may be described as a yellow sand, of a greenish tinge, comprising a yellow siliceous sand mixed with some green sand and a variable proportion of argillaceous matter. No data are at hand for determining its thickness, except the imperfect method of using width of outcrop and angle of dip, according to which we find the sand marl stratum to have a depth of 90 feet.

MARL BEDS.

The marl beds cover a comparatively small area in the State, and are practically limited to that division of New Castle county called St. George's Hundred.

The first important outcrops of green sand occur along the Delaware and Chesapeake Canal, the channel of which cuts deep into the formation. Its northern limit, as determined by old marl pits, runs approximately parallel with the canal, keeping a distance of from a quarter of a mile to a mile. From this line the marl extends southward to another boundary parallel with, and about one mile south of, Appoquinimink Creek, where it gives place to the Tertiary clays.

Subdivisions.—The divisions of the green sand formation are found, with two exceptions, to correspond with those made by the New Jersey Survey. In the first place, what is called by Professor Cook the Upper Marl bed, is in Delaware, entirely absent, and in the second place, the so-called *Red sand* is either entirely absent, or represented, as in the eastern part of the State, by a much thinner stratum than is found in New Jersey. This scanty development of the *Red sand* is, however, compensated for by a greater thickness of the *Indurated green marl*, which, in Delaware, becomes the prominent parting layer between the middle and lower marl beds. The chronological chart of the Cretaceous (II), will show the divisions of the marl beds as found in the State.

LOWER MARL BED.

This stratum, which extends as a narrow belt on each side of the canal, is found to outcrop along the entire length of the

same, rising about a foot above the surface of the water, and, farther west, to a height of 20 feet. The several subdivisions of the lower marl will be treated in the order of their age.

Cretoidal Marl.—This lowest layer is a tough, bluish black marl, which, upon drying, turns to a lighter ashen or earthen color, when it is found to be made of a large amount of green sand, siliceous sand and argillaceous matter. The solid particles are coated with chalky carbonate of lime, which, under the microscope, appears as a fine white powder of a granular character, but often light and flocculent.

Shell Layer.—The cretoidal marl is always found beneath a layer of shells or shell marl, having a thickness of about 3 feet. In fact, the shells are usually mixed with a greater or less quantity of the black earthy marl having the characters of the cretoidal variety. The shells are usually the characteristic species of the New Jersey equivalents, the most abundant being the clumsy *Exogyra costata* with *Pychnodonta vesicularis* and *Ostrea larva.*

Black Argillaceous and Micaceous Marl.—This layer, overlying the shells, in its lower part possesses somewhat the characters of the *cretoidal marl.* To the west of the Delaware railroad, however, it rises well out of the water of the canal, and assumes a distinctly argillaceous nature, becoming a black micaceous clay. It also shows an entire absence of calcareous matter, and possesses a decidedly styptic taste, due to the large quantity of sulphate of iron in the percolating waters. This argillaceous marl, when examined in the dry state by a glass, is found to be composed of minute sharp glassy particles of quartz, coated with a grayish dust, and associated with a few green sand particles of unusual fineness, together with a considerable quantity of minute scales of muscovite.

Thickness.—Fortunately we have sufficient evidence for measuring accurately the thickness of the lower marl bed. The belt has an average breadth of 1½ miles, which, with a dip of 40 feet to the mile, would give a thickness of 60 feet for the stratum. At Summit Bridge, the black marl outcrops to a height of 42 to 47 feet. Calling it 40, and adding this to 15 feet of marl in Higgin's pit, on much lower ground between St. George's and Delaware City, we get a total of 55 feet. Since the 15 feet excavation at the latter place failed to entirely penetrate the

marl, we may call 60 feet a safe estimate for the thickness of the lower marl bed. Of this total, more than one-half is represented by the argillo-micaceous layer, and the remainder by the thin shell layer, and the lowest cretoidal marl. There is one reason why the thickness of the lower marl stratum, as developed at Summit Bridge, should be employed in a calculation of the thickness, rather than the smaller figures obtained farther to the east or west. Summit Bridge is on the *dividing ridge.* From this meridional line, the land slopes to the east and west. The marl, therefore, offers a diminishing thickness of outcrop as the river is approached, owing to the erosion of the upper argillo-micaceous stratum, which, in the neighborhood of St. George's, and thence to Delaware City, has been thinned down to a thickness of only a few feet. It is for this reason that the upper portion of the lower marl bed is so extensively developed at the western end of the belt, while the lower portion of the same formation is confined to the eastern portion of the belt. Since the upper argillo-micaceous stratum is a poor, and even objectionable, material for fertilizing purposes, while the contrary may be said of the lower cretoidal variety, the locality for marl diggings must lie east of the railroad bridge.

Indurated Marl Bed.

The northern limit of this belt, which is also the southern limit of the lower marl bed, starts near the mouth of Scott's run, and thence keeps parallel with the canal to the railroad, when it begins slightly to diverge, cutting the headwaters of the northern branch of the Bohemia River. The southern limit of the belt can only be approximately outlined, but as can best be determined runs from Port Penn through the headwaters of Drawyer's Creek, and crosses the Maryland line four miles below the head of Bohemia River. The indurated marl stratum is divided into two layers, the lower red sand, and the upper indurated marl.

Red Sand.—The formation which has been called the indurated marl bed is the equivalent of the red sands of the New Jersey geologists, it being, in both cases, the prominent parting layer between the lower and middle marl. Along the south side of the canal, between the railroad bridge and St. George's, a soft reddish yellow sand of uniform character rests upon a stratum of black marl. It is developed to a considerable thickness in the neigh-

borhood of the latter town, and is characterized by the numerous particles of green sand contained in it. The thickness could not, however, be accurately determined, running as it does, indistinctly into the overlying gravels. West of the railroad, the deposit thins out entirely, and does not again appear. Along the ravine made by Scott's Run the red sand has been found lying upon the shell marl, running to the south into a black decomposed green sand. Notwithstanding the deposit of red sand, which outcrops along the south shore of the canal, the shell marl is dug by several parties on a strip along the same side, and for this reason, I have extended the southern limit of the lower marl belt slightly to the south of the southern shore of the canal.

Considering the foregoing facts, the writer with some trouble that cannot well be removed, has referred the reddish yellow sand stratum to the red sand of Prof. Cook. This red sand occupies a narrow strip along the south side of the canal, to the east of the railroad, and runs to the south beneath the overlying stratum of decomposed marl, by which nearly the whole area of the bed as previously marked out, is covered. From this we see that the true red sand, which is so extensively developed in New Jersey has a less thickness in Delaware, but is replaced by the indurated marl, which in New Jersey is found more thickly exposed, but occupying the same stratigraphical position above the red sand.

Indurated Green Sand.—This marl attracts from the observer more attention than any other, coming to the surface as it does in numerous localities, and having been extensively worked for its pre-eminent qualities as a fertilizer.

Already in a state of partial decomposition, the decay rapidly progresses by the removal of the potash, and the oxidation of the ferous salt of iron, or its direct solution by carbonated water. Generally speaking, the marl in the bed is of a black, loamy nature which, when dry, assumes a brownish or grayish tinge. It is made of a variable quantity of green sand, with a large proportion of siliceous sand. In some places the marl is found to contain a large amount of argillaceous matter, while again it is extremely clean and dry. It differs entirely from the lower marl, by containing no carbonate of lime in the pulverent state; but in certain places the deposit abounds in shells, which renders it comparable with the shell marl of the former formation.

Examined with a glass, the grains of indurated marl prove of

a brownish color, and very rough and irregular, apparently the effect of weathering. The grains can easily be crushed by the finger-nail, thus exposing the internal green color. The granules are coated with a layer of brown oxide of iron, within which shell exists the unchanged nucleus of glauconite.

The *Indurated Marl*, unless finely pulverized, has a lumpy tendency, caused by numerous grains of green sand cemented by the brown oxide of iron. In fact, the marl has, at certain points, been almost entirely changed to brown oxide of iron, while in other cases, seams of the latter penetrate the mass of the green sand. Prof. Cook is of the opinion that the red sand of New Jersey is due to the decomposition of green sand, whereby the soluble salts have been carried away, leaving the insoluble siliceous sand and red oxide of iron. We may, therefore, regard the belt, which in New Jersey is called the red sand, and in Delaware the indurated marl, as a true marl belt in a greater or less degree of decomposition; and while a slightly indurated green sand may entirely differ mineralogically from a red siliceous sand, the difference is after all only one of degree of decomposition.

Middle Marl Bed.

This belt crosses the State with a uniform breadth of three and a half miles, the northern line running from Port Penn, a little north of Drawyer's creek, and crossing the State line four miles south of the Bohemia River. The southern line crosses the centre of Noxontown mill-pond, keeping parallel with and a little south of Appoquinimink creek. The middle marl bed (see II) is divided into three very distinct layers: (1) A lowermost pure green sand; (2) an intermediate layer of friable shells, and (3) an upper yellow or reddish yellow sand. The characters of these several strata will be considered as follows:—

Green Sand Layer.—This lowermost subdivision of the middle marl bed occupies the main width of the belt to the north of Appoquinimink Creek, and exhibits its principal exposures along Drawyer's Creek and Silver Run, where its characters may be well studied. It differs entirely from any of the foregoing varieties, in that it is entirely free from calcareous matter, and shows none of the general induration so characteristic of the previous formation. On the contrary, it is a very dry, pure green sand, which varies in color from a deep bluish to a yellowish green, the latter shade being due to a considerable admixture of siliceous sand.

The extreme dryness of this marl, compared with the preceding varieties, is owing to the complete absence of argillaceous matter. The grains, when examined, are smooth and well rounded, and although frequently so soft as to be easily crushed by the nail, show no evidence of chemical decomposition.

Shell Layer.—This intermediate, well-defined layer, is best exposed at the head of Noxontown mill-pond, and along the south side of Appoquinimink Creek. In thickness it varies from 3 to 10 feet, being entirely made up of white friable shells, tightly packed together, the most common of which are *Terebratula fragalis* and *T. Harlani*, with *Pychnodonta vesicularis.*

Very often the upper part of the shell layer has lost its carbonate of lime, which is replaced by brown oxide of iron. At the head of Noxontown mill-pond, the white shell layer, of which the upper part is ferruginous, rises 5 to 6 feet out of the water, capped by a yellow sand marl.

Yellow Sand.—This is the uppermost layer of the Middle Marl Bed, and is always found associated with and overlying the shells. It may be described as a yellowish or reddish sand, containing a small and variable proportion of glauconite, the latter often becoming so predominant as to give the deposit a decidedly greenish tinge.

Dioritic Trap.

Three miles to the south of Newark, Delaware, Iron Hill rises from the Cretaceous plane, the one conspicuous object for 10 miles or more. Running in a generally northwest and southeast direction, it has a length of over 3 miles, a width varying from 1 mile to 1½, and a height of 225 feet. The flanks and summits of this hill are covered with boulders of diorite and cellular quartz. On the south side, about half way up, is seen the outcrop of a bedded mass of serpentine rock, with a strike following the trend of the hill. An examination of the loose fragments of green rock lying upon the surface showed them to be composed of a number of indefinite chloritic and serpentine materials in a state of partial decomposition. As the greenish fragments were also observed to run into unchanged trap, occurring as huge outcropping boulders, the proof appeared conclusive that the serpentine rock had been due to the alteration of the hornblende in the dioritic trap. Following the hill in its northwest course, we find the same rock crossing the railroad, along the cutting of which the nature of the dike is revealed.

Here we first pass some 200 feet of a soft greenish clay, which rises as walls 20 feet high. Fragments of the serpentine rock, on the surface above the railroad cutting, showed it running into unchanged diorite. Lying next to the serpentine rock was 50 feet or more of both compact and cellular quartz, standing upon edge, and striking to the northwest. It was completely impregnated with minute specks and octahedrons of magnetite, which exhibited their decomposition by numerous minute cells filled with iron oxide. The cellular quartz, associated indiscriminately with the compact, was literally honeycombed, the great cells being partially filled with ochrey powder. West of the quartz occurred a thinner development of the serpentine, offering the same features as before. With these facts, we are led to regard the exposure before us as a highly changed dioritic dike, in the centre of which is a huge mass of ferruginous jaspery quartz, from which we interpret the structure of the whole hill. Attaining the summit, we find several large pits worked for iron ore. One of them, wrought by George Whitaker, has walls of soft greenish serpentine earth rising some 40 feet, in which are imbedded boulders and fragments of cellular ferruginous quartz and iron-stone, together with a considerable admixture of ochrey powder and granular limonite. The economic value of the workings consists in washing the serpentine earth, and extracting the limonitic materials. Near the wash-house the yellowish green rock is seen to outcrop with a strike to the northwest. Several of the pits on the hill offer much the same features, while some of them contain a greater abundance of the boulders of cellular quartz. The method of formation of the crusts of iron-stone may be determined by an examination of the numerous quartzose boulders. It consists in the segregation of iron oxide as tortuous veins within the substance of the rock, set free by the complete disintegration of the latter; while the powdery and granular limonite has resulted from an oxidation of the magnetite which so completely impregnates the jaspery quartz. Associated with the boulders of trap, are certain foreign materials belonging to the drift. Imbedded within the serpentine earth of Whitaker's pit, are several large decomposed boulders of granite. Upon the summit of the hill, a large boulder of dark limestone was also found, besides various other materials belonging to the boulder drift so universally scattered over the State,

OCTOBER 21.

MR. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-nine persons present.

The following papers were presented for publication:—

"On the Cuspidiform Petroglyphs, or so-called Bird-track Rock-Sculptures, of Ohio," by D. G. Brinton, M. D.

"Preliminary Observations on the Brain of Menopoma," by Henry F. Osborn.

OCTOBER 28.

The President, DR. LEIDY, in the chair.

Thirty-nine persons present.

Organisms in Ice.—Prof. LEIDY stated that a member had placed in his hands, for examination, a vial of water obtained from melting ice which is used for cooling drinking-water. From time to time, among some sediment taken from a water-cooler, the gentleman had observed what he supposed to be living worms, which he suspected were introduced with the water into the cooler, and not with the ice. Upon melting some of the ice alone, the worms were still observed, and the water submitted for examination was some that was thus obtained. Prof. Leidy was surprised to find a number of worms among some flocculent sediment, mainly consisting of vegetal hairs and other debris. Besides the worms, there were also immature Anguillulas, and a number of *Rotifer vulgaris*, all living. It would appear that these animals had all been contained in the ice, and had been liberated on melting. It was an unexpected source of contamination of our drinking-water, that Prof. Leidy had previously supposed to be very improbable. The little worms he was not familiar with.

They belong to the family of Lumbricidæ, and probably may be an undescribed species of *Lumbriculus*. They are white, or colorless, from 4 to 6 millimeters long, by a third of a millimeter in thickness. The body is divided into thirty segments, bearing podal spines, which form four rows, with three in each fasciculus, and divergent. The spines are curved at the root, pointed at the free end, and measure 0·05 to 0·06 mm. long. The upper lip is blunt conical; the terminal segment truncate. There appears to be no distinct girdle, but the third, fourth, and fifth segments contain capsuligenous glands and other organs pertaining to the sexual apparatus.

Several dead worms swarmed in the interior with large, ovate, beaked, ciliated infusorians measuring from 0·05 to 0·06 mm. long by 0·04 to 0·048 mm. broad.

Chapter I, Article 6, of the By-Laws was amended by the addition of the following:—" Neither the building occupied by the society, nor any part of the site or ground pertaining thereto, shall be sold, leased, encumbered or charged in any manner whatever, nor shall any apartment or space in the Academy or adjacent ground be assigned or appropriated permanently to the exclusive use of any person or to the accommodation of any special collection or collections, unless the proposition in this connection be in writing, signed by at least five members, presented at a stated meeting of the Academy, referred to the Council for examination and report—which report shall be considered as special business, to be acted upon at a subsequent stated meeting, to be held at least twenty-six days after that at which the report of the Council has been read, the date to be fixed by resolution; but no action shall be taken thereon until after full notice thereof and of said date shall be given to the members by advertisement once a week, for three weeks in two daily newspapers of general circulation in Philadelphia, and by written or printed notice by mail or otherwise to all the members whose residences or places of business shall be known to the Recording Secretary. At such meeting the measure proposed may be considered and adopted by two-thirds of the members present at that meeting, or at any subsequent adjourned meeting for that purpose, provided that at least eighty members be present and vote; and provided also that nothing in this article shall be so construed as to change, alter or repeal Art. 5, Chapter XI, or release the curators from the charge and care of collections, as provided for in these by-laws."

Chapter XVI, Article 4, of the By-Laws was amended as follows:—In the third line, after the word "inclusive," insert the words "except Article 6, Chap. I" and add the followings words or paragraph:—" Article 6, Chap. I, may be amended, altered or repealed by two-thirds, upon a yea and nay vote of not less than eighty members, at a meeting called to consider that special business, after advertisement and individual notification of the members, in manner and form specified in said article, but not otherwise."

The following were elected members:—George Fales Baker, W. B. Scott, Edmund J. James, and H. LaBarre Jayne.

The following were elected correspondents:—G. Vom Rath, of Bonn, and Geo. E. Dobson, of London.

The following were ordered to be printed:—

PRELIMINARY OBSERVATIONS UPON THE BRAIN OF MENOPOMA.

BY HENRY F. OSBORN, SC. D.

This is the second of a series of papers[1] upon the brains of the American Urodela. In the study of *Menopoma*, I have detected numerous errors in the first paper upon *Amphiuma*,[2] and my attention has kindly been called to others by Prof. Wilder and Dr. E. C. Spitzka.

The brains of *Amphiuma* and *Menopoma* are even more alike in their internal than in their external structure; while the reverse is the case in the comparison of *Menopoma* and *Menobranchus*, which resemble each other very closely externally, but in longitudinal section present important differences.

The greater accuracy of the Menopoma work is due to changes in technical methods. Before hardening, the brains were inflated with Müller's fluid, so as to preserve the natural proportion of the cavities. After treatment with alcohol, they were placed for a week in dilute carmine. Calberla's egg-mass was employed as before, except that the ventricles were injected with the mass before hardening. The delicate parts of the brain-roof were thus retained. It appears now that celloidin may be used for this purpose to equal, if not to greater, advantage in results, and with considerable economy of time. The sections were cut in absolute alcohol, were then floated upon a slide in consecutive order, from twenty to fifty at a time, and were covered with a delicate slip of blotting-paper during treatment with oil of cloves. These changes greatly improved the three series, which were obtained in as many planes—horizontal, transverse and vertical to the long axis of the brain.

EXTERNAL STRUCTURE (Pl. VI, figs. 1, 2, 3).

With a single exception, and that an important one, the brain of *Menopoma* approaches closely the typical brain. The seg-

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[1] Many of these results were presented in the Biological Section of the American Association, September, 1884.

[2] Preliminary Observations upon the Brain of Amphiuma. Proc. Phila. Acad. Nat. Sc., July, 1883.

mental[1] parts are clearly differentiated from each other in regular succession, beginning with the olfactory lobes or Rhinencephalon, the Prosencephalon, the Diencephalon, the Mesencephalon, the Epencephalon and Metencephalon. This was not found to be the case in *Amphiuma*, where the Rhinen- and Prosencephala and Dien- and Mesencephala are barely distinguishable. The exception above noted is that, the epiphysis does not appear upon the external surface, but, as we shall see, is altogether wanting, while a vascular plexus lying between the hemispheres offers a very deceptive imitation of this important structure. The hypophysis and infundibulum, however, have a striking development.

A careful study of the surface of the diencephalon discloses a minute transparent area lying between two whitish streaks. The latter are transverse commissures in the roof of the third ventricle; the former is the cavity of the epiphysial tube, or recessus pinealis, the brain-cavity being separated from the pia mater only by a single layer of cells. This transparent area has already been pointed out by Goette[2] in the frog, where it is somewhat less conspicuous. In front of the foremost commissure is a triangular transparent space; at the sides of this are two horn-like forward continuations of the diencephalon. These processes I consider homologous with the habenulæ of the mammalian brain, and with the "Schnabelförmiger Fortsatz" described by Müller in the lamprey's brain. In the lamprey they coalesce in

[1] The nomenclature proposed by Prof. Burt G. Wilder has been adopted, with few exceptions. It proceeds upon the consistent plan of naming the segments, and their various parts, as far as possible, after the segmental names which now meet with general acceptance among anatomists; also of using abbreviated forms of the longer terms now in use. For the sake of clearness the new terms, and their synonyms, which are employed in this paper are given below. The *Prosencephalon*, including: the *procœliæ*, lateral ventricles; the *proplexi*, lateral plexuses; the *prosocœlia*, ventriculus communis laborum; the *supraplexus*, plexus in the roof of the prosocœlia; the *porta*, foramen of Munro; the *terma*, lamina terminalis; the *præcommissura*, anterior commissure. The *Diencephalon*, including: the *supracommissura*, commissura habenarum; the *processus* and *recessus pinealis*, the *postcommissura*, posterior commissure; the *diacœlia*, third ventricle. The *Mesencephalon*, including: the *mesocœlia*, iter, etc. A system of this kind must undergo modification, from time to time, but in the end it will be far superior to the present cumbersome multinomial system.

[2] Entwickelungsgeschichte der Unke, 1875.

the median line, but here they are separate, as may be seen by a close external examination, and verified by transverse sections. This homology is confirmed by the study of the foremost of the transverse commissures. In front of this space rises the reddish body, which has been generally mistaken for the epiphysis. In the natural state this body is not very prominent, but as soon as the ventricles collapse, it is thrust conspicuously upwards. The ventricular collapse is also the occasion of an artificial dorsal furrow in the optic lobe, which is here absolutely unpaired. Upon the ventral aspect of the brain we again observe two transparent areas. One resembles a long slit in front of the optic chiasma, and is found to be a portion of the lamina terminalis. The other is due to a thinning of the floor of the infundibulum, and is seen immediately in front of the hypophysis. The hemispheres are closely applied to each other, but have no structural union. The cerebellum is slightly overhung by the optic lobe.

The proportions of the various segmental parts are very similar to those of *Menobranchus*, and this seems to accord with the similarity of the proportions in the head, body and limbs of these animals.

INTERNAL STRUCTURE.

A natural introduction to the internal structure would be a description of the walls and cavities of the various segments, but it happens that the boundaries of these segments can only be determined after we settle upon the relations of the parts which compose them, so, until some of the details have been investigated, this description must be postponed. In general, the brain is a tube forking in front into the paired lobes and cavities of the hemispheres.

The Ependyma and Pia Mater.—The pia mater closely invests all the brain surfaces and sends numerous nutrient vessels into its walls. It envelops all parts of the brain, with the exception of the hypophysis, which lies external to it (fig. 4), so that the pia actually separates the hypophysis from the floor of the infundibulum and sends in numerous smaller vessels between the epithelial tubes which constitute this body. This relation is not true of the posterior lobe of the hypophysis which is a development of the brain-wall and is surrounded by the pia, the anterior lobe as is well known, arising from the oral epithelium.

At several points the pia and ependyma unite to form the sole elements of the brain-wall, giving the transparent effect, in external view, which has been mentioned. A striking instance of this is seen in the dorsal wall of the infundibular cavity, which is extremely delicate, the ependyma consisting of a single row of cells. The vascular plexuses above the medulla and between the hemispheres are instances of such union, elaborated by the introduction of vascular plexuses from the pia. Three varieties of the cells of the ependyma can be distinguished. The cells of the first variety form a general investment of the inner brain-wall; they are from one to three deep, cylindrical or much elongated, crowded between them are yellowish oily granules, and many of the cells remotely resemble ordinary fat cells in the possession of a proto-plasmic nucleated centre, lying between yellowish, unstained terminations. It is the innermost of these cells which give rise to thread-like processes which radiate outwards in the brain-wall, but the latter never make such beautiful displays as are seen in the frog's brain, and figured by Stieda.[1] The cells of the second variety lack the fatty granules; they are found coating the *præcommissura*, but are principally observed wherever the brain-wall is reduced to a single row of cells as in the roof of the infundibulum, and in that part of the floor to which the hypophysis is attached; they are small, rounded cells, at one point becoming very much elongated, namely, in the sides of the *processus pinealis*. The transition from this to the third variety is beautifully shown in the forward portion of the roof of the third ventricle. Here the rounded passes into the beaded character of the single cell layer which follows the elaborate foldings of the *diaplexus*.

The consecutive series of sections in three planes afford fine material for the study of the nerve-fibre courses, and much has already been ascertained that throws light upon the relations of the brain segments. I will here describe only the fibre courses which have a transverse direction, considering under this head the relations of the cerebellum,[2] the origin of the optic nerves, and the various commissures.

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[1] Zeitschrift für wiss. Zool., Band xx.

[2] Compare E. C. Spitzka. The relations of the Cerebellum, Alienist and Neurologist. New York, January, 1884.

The Cerebellum (figs. 6, 7).—Numerous as are the errors which at present prevail in the literature of the amphibian brain, none are more striking than those relating to the cerebellum.[1] It is said to retain its embryonic condition of a small band-like structure stretching over the fourth ventricle. Now it happens that the amphibian cerebellum is a flat structure, and if viewed on edge, as is the case in looking down upon the frog's brain, it does appear very small; if, on the other hand, it is seen in vertical longitudinal section, its large bulk, relatively to other parts, is at once apparent. If, further, as will be done in another paper, a corresponding section of an amphiuma brain be superposed upon the frog section, we find that the former barely covers one-twenty-fourth of the diameter of the latter, although the Amphiuma is a very much larger animal. The description referred to above, then, is as exaggerated when applied to the frog as it is true of such forms as *Amphiuma*, *Menopoma* and *Menobranchus*.

In *Amphiuma*, the cerebellum is reduced to its simplest possible expression. It seems doubtful whether it contains any nerve cells whatever. In *Menopoma*, however, a few cells similar to those in the optic lobes, can be observed on either side of the transverse fibres which make up the larger part of this body; it is difficult to distinguish these cells from those of the ependyma. Notwithstanding the character of this body, its main relations to the adjoining parts are precisely similar to those of the higher vertebrates. These relations have already been indefinitely indicated by Stieda. (1.) From the lateral tips of the medulla arises a column of fibres on either side, which arches forward; here the columns are reinforced by fibres apparently arising from lateral cell-masses, these columns turn back and enter the cerebellum. (2.) Passing beneath these columns is another pair, which diverge and then converge as they enter the pars peduncularis of the mesencephalon; they can be followed some distance forwards upon either side of the mesocœlia. (3.) Passing directly forward from the ventral surface of the cerebellum, a few scattering fibres enter the valvula and with some doubt can be followed into the cells of the roof of the optic lobe. In one and two we recognize the post- and præ-pedunculi or inferior

[1] Mihalkovics, *loc. cit.*, p. 56; also, Wiedersheim, Lehrbuch der Vergleichenden Anatomie, 1888, p. 297.

and superior (processus ad cerebrum) peduncles of the higher vertebrate brain.

The scarcity, if not absence, of nerve cells in the Amphiuma or Menopoma cerebellum, renders it difficult to understand the meaning of these peduncles, unless we regard the cerebellum here as in large part a decussational system, composed of fibres crossing from one side of the brain to the other. It may be added that the frog's cerebellum is richly cellular.

The Optic Nerves (fig. 8).—No fibres have as yet been followed from the optic lobe (Mesencephalon) to enter the optic tracts, although there can be little doubt that they are present; but the fibres in the thalami arise in a manner which points, almost with certainty, to the important fact that in the Amphibia the *decussation of the optic tracts is incomplete.* In other words, part of the fibres of each optic nerve enter from the chiasma, *i. e.*, from the opposite side of the brain, part enter from the same side of the brain. (1.) The fibres supplying the chiasma, arise from cell masses in the upper lateral portions of the thalami, and sweep around the sides of the thalami, partly encircling the main longitudinal fibre system (crura cerebri); they pass downwards and obliquely forwards, enter the chiasma, and apparently pass to the nerve of the opposite side. (2.) In the floor and lower lateral cell masses of the thalami arise smaller bundles of fibres, which pass beneath the longitudinal system, above and then in front of the chiasma to enter the optic nerve of the same side. They can be traced by following successive sections forwards, but do not interdigitate with the fibres of the chiasma, as in the figure which combines the results of a series of sections. If this fact is confirmed by other observers, it will show that the partial decussation of the optic tracts is an early, if not a primitive condition, instead of being peculiar to the higher mammals, as has been generally maintained.

The Commissures.

The Præcommissura (fig. 9).—In the frog's brain [1] it has been found that there are two divisions of this commissure: a posterior, connecting the lower portions of the hemispheres, and an anterior, connecting the upper median walls. Both have been found in *Menopoma*, the latter arching upwards at the sides, and, as is clear in fig. 4, it forms on either side the posterior boundary of

[1] Stieda, *loc. cit.*, p. 808.

the porta, or passage from the single to the lateral cavities of the Prosencephalon. In *Menopoma*, however, the posterior division is immediately below the anterior, and it is found in the horizontal sections to be not a true commissural, but a decussational system. At this point, a large number of the fibres composing each of the longitudinal tracts, just mentioned in connection with the optic chiasma, cross each other and pass to or from the base of the opposite hemisphere. In *Menobranchus* these two tracts are completely separated, the upper division passing independently across the ventricle.

The Postcommissura.—Although this commissure is part of a conspicuous fold of the brain-roof separating the Dien- from the Mesencephalon, it really contains in the Amphibia but few fibres. Another interesting fact is that these fibres do not enter into the thalami, but pass obliquely backwards into the region of the longitudinal tracts composing the pars peduncularis of the Mesencephalon. This accords with Mihalkovics'[1] observations upon the chick, and tends to confirm Pawlowsky's[2] view that this is not a commissure in the strict application of the word, but is rather a side connection of the longitudinal fibre system. This view accords also with Ahlborn's recent observations upon the lamprey.

The Supracommissura (fig. 8).—In the forward portion of the roof of the diacœlia, and immediately above the optic chiasma is a commissure, which, as far as I can ascertain, has been heretofore entirely overlooked in the Amphibia. In *Menopoma* and *Amphiuma* it is very large; in the frog it is much reduced, and lies further forward; in *Menobranchus* it is represented by a slender band of fibres immediately in front of the *recessus pinealis*. In all these forms it lies in front of the epiphysial process, and completely separates this tube from the dia- and supraplexus. It occupies the same relative position as the variously named *Commissura habenarum*,[3] or the commissure of the pineal stalk (Mihalkovics)[4] of the mammalian brain, as well

[1] *Loc. cit.*, p. 73.

[2] Pawlowsky, Ueber den Faserverlauf in der hinteren Gehirncommissur. Zeits. für wiss. Zool., Band xxiv, 1874.

[3] Wilder, Anatomical Technology, 1882, p. 452.

[4] *Loc. cit.*, p. 100. This comparison is somewhat doubtful.

as the commissure figured by Professor Balfour[1] in the Elasmobranch brain. It passes across the posterior ends of the hook-like processes of the thalami, which I have compared with the habenulæ, and the most satisfactory interpretation of this commissure is afforded by a comparison with Ahlborn's figures of the lamprey brain.[2] At the sides and to the front of the *recessus pinealis*, I find in *Menopoma* two compact masses of nerve cells, which I think we may compare with the *ganglia habenarum*. These masses form the posterior, and to some extent the inferior, boundary of the *supracommissura*. Following the fibres of this commissure downwards and forwards, we find that they partly enter the thalami, while the greater part pass directly into the hemispheres. Their distribution, then, is similar to that of the fibres of the *tænia thalami optici*, while the commissural portion may be compared with a slender commissure, the *commissura tenuissima*, traversing the habenulæ in the lamprey's brain. The relations to the hemispheres are especially interesting, as they indicate, between the posterior parts of these bodies, a commissural union of considerable extent and importance.

Infundibular Commissures.—The lobes of the infundibulum are united dorsally and ventrally by two commissures, the uppermost being quite distinct and extensive (fig. 4) and forming the thin fold which divides the iter from the infundibular cavity.

The Hypophysis and Epiphysis.

The backward extension of the *hypophysis*, together with its great development, and the unusual size of the infundibular cavity and lateral lobes, lend this portion of the brain especial interest. I will, however, only remark here upon the clear separation of the anterior and posterior lobes of the hypophysis, by the turning in of the pia mater over the forward face of the anterior lobe (fig. 4). The vessels of the pia ramify between the columnar epithelial cells, which compose the tubes forming this lobe. In vertical section the lumen of one of these tubes is occasionally seen. The ependyma is much convoluted in the posterior lobe, and these foldings may readily be mistaken for tubes.

Our knowledge of the *epiphysis* in the Amphibia is in a far from satisfactory state. There can be little doubt as to the correctness

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[1] Elasmobranch Fishes, plate xv.

[2] *Loc. cit.*, p. 285.

of Goette's important observation[1] that in the batrachia the epiphysis proper loses its primitive connection with the brain, and lies external to the skull, while its primitive union with the brain is indicated by the more or less degenerate walls of the epiphysial tube. Yet Goette's figures do not give such a clear history of these changes, as the importance of the subject demands, and so far as we know, there have been no embryological investigations on this subject among the urodela.

In the meantime, since the publication of Goette's discovery, many general works[2] by different writers upon comparative anatomy have appeared, all of which figure the epiphysis as a conspicuous object lying between the cerebral hemispheres. There can be little doubt that these, as well as all the earlier writers upon the Amphibian brain, such as Wyman, Ecker, Leidig, Rathke and Stieda have mistaken the remarkable upgrowth of the vascular plexus above the prosocœlia for the epiphysis, and that this body in the urodela, as well as in the batrachia, is represented upon the brain surface merely by a portion of its primitive stalk. The grounds for this statement, so far as it concerns the urodela, are that in *Amphiuma*, *Menobranchus* and *Menopoma* portions of this primitive stalk can be seen in vertical section, in different stages of arrest, and retaining to a greater or less extent the primitive condition of a glovefinger-like upfolding of the brain roof.

In the discovery of the supracommissura and the invariable position of the recessus pinealis, between this and the post-commissura, we find unmistakable anatomical evidence for Goette's conclusions, although we are not thereby warranted in assuming that the development of the epiphysis is the same in the urodela as in the batrachia. All doubt is also removed as to the connection between the stalk of the epiphysis and the supraplexus, as the latter is clearly distinct from the former, and does not establish such close relations with the stalk as in the birds.

In *Menopoma* (fig. 4) the ependyma cells upon either side of the recessus become much enlarged and elongated; upon the upper surface of the brain they lose this character, becoming

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[1] Entwickelungsgeschichte der Unke, 1875, p. 283.

[2] Huxley and Martin's Practical Biology, Wiedersheim's Lehrbuch der vergleichenden Anatomie and Wilder's Anatomical Technology may be cited as examples.

small and spherical, and folding over, form a single-layered much flattened sac, the lumen of which retains its connection with the diacœlia by a narrow slit. This is the only adult trace of the *processus pinealis* in *Menopoma*. In *Rana* (fig. 5) I find the same elongation of the ependyma cells, and similar cells forming the processus, but in a double row. Here the supracommissura is much smaller, and more widely separated from the postcommissura, this interval is bridged by a delicate single row of cells which appear to turn up and form the anterior border of the recessus, although this point is not very clear. There is also some doubt whether the lumen of the processus retains its communication with the diacœlia. The processus itself is a long, flattened, two-layered sac, circular in section, extending anteriorly so as to overlap the supracommissura. The pia mater overlaps the processus upon all sides, indicating that it primitively was directed upwards. Extending from above the *postcommissura*, forwards to the base of the epiphysial stalk, are numerous fibres, which appear to enter into relations with the cells of the stalk. In *Menobranchus* and *Amphiuma* we find a nearer approach to the frog than to the *Menopoma* condition, the processus forming an elongated flattened sac, completely constricted off from the brain cavity.

The Plexi choroidei.—There is a singularly simple and beautiful display of the relations of the intra-ventricular blood-vessels in the brain of *Menopoma* (fig. 4). The thrusting in of the ependyma extends from the supracommissura to the upper portion of the terma. The arterial supply is apparently derived from the median arteria carotis cerebralis, and the venous return is at the sides of the supraplexus. The division into supra-, dia- and proplexus is a somewhat artificial one here, but is not so when applied to the Amphiuma brain, where the supraplexus is very prominent, and the diaplexus extends well back into the Mesencephalon. The lateral wings of the diaplexus are shown passing through the porta in fig. 9. The nature of the ependyma cell-lining of these vessels is very constant; small and large, the cells have the same elongated, bead-like appearance.

The Encephalic Segments.—Stieda,[1] following general usage, considers that portion of the median brain-floor lying behind the

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[1] *Loc. cit.*

chiasma as the lamina cinerea; that lying in front, as the lamina terminalis. This construction cannot be applied here with accuracy, owing to the unusual position of the *præcommissura*, in the brain-floor, instead of in the anterior median wall. Yet for comparative purposes it is best to retain this interpretation. It gives us an unusually extended prosocœlia, or ventriculus communis loborum, which we find is a distinctive feature also of the Amphiuma and Menobranchus brain. The *supracommissura* may be considered as the upper posterior boundary of the prosocœlia, separating it arbitrarily from the diacœlia, as the *postcommissura* does the dia- from the mesocœlia. At all events, the supraplexus clearly belongs to this cavity rather than to the diacœlia.

The general subject must be discontinued here, to be resumed in connection with the brain of the Menobranchus, in a subsequent paper.

MORPHOLOGICAL LABORATORY, PRINCETON, *Oct. 20, 1884.*

EXPLANATION OF PLATE VI.

ILLUSTRATING THE BRAINS OF MENOPOMA AND RANA.

Encephalic segments Rh.—Rhinencephalon; *Pr.*—Prosencephalon; *Di.*—Diencephalon; *Me.*—Mesencephalon; *Ep.*—Epencephalon; *Met.*—Metencephalon.

General Abbreviations.

a.—Prosocœlia, cavity of the primitive prosencephalon.
a. hph.—Anterior lobe of hypophysis.
a c c.—Branch of *Arteria carotis cerebralis.*
cbl.—Cerebellum.
ch.—Optic chiasma.
cn. ce.—Canalis centralis.
dc.—Diacœlia, third ventricle.
dpx.—Diaplexus, choroid plexus of the third ventricle.
end.—Ependyma.
h.—Habenulæ.
hem. and *hem'.*—Section and external surface of right hemisphere.
hph.—Hypophysis.
i. cm.—Inferior commissure of infundibulum.
l.—Longitudinal fibre courses, cut transversely.
med.—Medulla oblongata.
msc.—Mesocœlia, iter.
mtc.—Metacœlia, fourth ventricle,
mtpx.—Metaplexus, *tela vasculosa* of the fourth ventricle.
my.—Myelon, spinal cord.

opt.—Optic lobe.

p.—Porta, Foramen of Munro.

pcs.—Postcommissura, posterior commissure.

p. hph.—Posterior lobe of hypophysis.

pi.—Pia, pia mater.

ppd.—Post-pedunculus, posterior peduncle of cerebellum.

pp.—Pars peduncularis of Mesencephalon.

prc.—Procœlia, lateral ventricle.

pr. cs. and *pr. cs'.*—Præcommissura, anterior commissure, lower and upper divisions.

pr. eph.—Processus pinealis, the epiphysial stalk.

pr. px.—Proplexus, the choroid plexus of the lateral ventricle.

pr. pd.—Præpedunculus, anterior peduncle of cerebellum.

r. eph.—Recessus infra-pinealis, the opening of the epiphysial cavity into the diacœlia.

rhen.—Section of olfactory lobe.

rst.—Restiform tract.

scs.—Supracommissura, commissure of the habenulæ.

scm.—Superior commissure of the infundibulum.

spx.—Supraplexus (formerly considered the epiphysis), the upper portion of the vascular plexus of the prosocœlia.

spd.—Supra-pedunculus, fibres passing from the cerebellum into the optic lobe.

t.—Terma, lamina terminalis.

FIGURES 1, 2, 3. Dorsal, ventral and lateral aspects of the brain of *Menopoma Alleghense*, enlarged five diameters. The whitish band stretching across the infundibulum, in front of the hypophysis, probably consists of the inferior infundibular commissure. In the dorsal aspect of the fresh brain, the position of the epiphysial process, is marked by an oval transparent area, in front and behind which, the supra- and post-commissuræ shine through. This area is undoubtedly contracted by reagents. The natural backward direction of the cerebellum is also altered, so that it hangs beneath the optic lobe.

FIGURE 4. Longitudinal vertical section of the brain of Menopoma, in a median plane as far forwards as the terma, and in front of this through the centre of the right hemisphere; enlarged sixteen diameters. The dotted ellipse indicates the position of the porta, or foramen of Munro.

FIGURE 5. The diatela, or roof of the third ventricle of the brain of *Rana Mugiens*. This figure represents the long tubular epiphysial process, composed of two or three rows of cells, mostly enveloped by the pia and extending forwards above the supracommissura. The inner layer cells send short processes into the persistent cavity of the epiphysis, and the cavity is filled by a highly transparent meshwork, which may simply consist of coagulated fluid. The opening into the diacœlia, *r. eph.*, is doubtful. The lines (*fl.*), indicate a number of nerve fibres, which apparently extend to the base of the epiphysial process.

FIGURES 6–9 are of *Menopoma*.

FIGURE 6. A composite of three transverse sections through the cerebellum and medulla.

FIGURE 7. Diagrammatic representation of the nerve fibre courses springing from the cerebellum.

FIGURE 8. A composite of six sections through the diencephalon, showing the course of the fibres of the supracommissura, and probable origin of the optic tracts. *a–a′*, supposed course of fibres passing from upper parts of thalamus to optic nerve of opposite side. *b–b′*, course of fibres from lower parts of thalamus to optic nerve of same side.

FIGURE 9. An oblique section through the region of the præcommissura, showing the distributions of the fibres of this commissure, also the supraplexus, the proplexus, and porta. The right side is cut anterior to the left.

ON THE CUSPIDIFORM PETROGLYPHS, OR SO-CALLED BIRD-TRACK ROCK-SCULPTURES, OF OHIO.

BY DR. D. G. BRINTON.

In the study of American rock-sculptures, the attention of archæologists has several times been drawn to a peculiar character which appears frequently on the inscribed rocks of central and northern Ohio, and rarely, or not at all, outside of this region.

It has been called a bird-track or specifically, a turkey-track, and has been supposed to be a conventional representation of the impression of the foot of this or some other bird. A recent study of one of the best examples of it, near Newark, Ohio, has led me to a different opinion as to its significance, and I take the occasion to explain this, and also to offer some suggestions as to the distribution and purport of this design.

In Ohio, rocks bearing this figure are found near Barnesville, Belmont Co.; near Amherst, Lorain Co.; at Independence, Cuyahoga Co.; in Licking Co., and elsewhere. It does not occur in the rather numerous inscriptions upon the Ohio River, nor in those south of that stream. Nor has it been reported in the various petroglyphs existing in the Susquehanna Valley and in New England. In fact, it seems confined pretty closely to that area which was occupied by that people whom we call, for want of a better name, the mound-builders. This adds interest to the investigation of the character and its meaning.

That it possessed some definite signification would seem to be demonstrated by the frequency of its recurrence and the regularity shown in its tracings; this indicating that it was a familiar figure, and that constant repetition had conferred on the designer a certain technical skill in forming it. This would not be the case were it merely the product of an idle hand, and of no import.

As I have said, this peculiar figure does not occur in other American rock-inscriptions. It is, indeed, very rare in any other locality. Dr. Richard Andree, in his "*Ethnographische Parallelen*" (Stuttgart, 1878), gives drawings of fifty-nine rock inscriptions from various parts of the world, but on examining them I find only one which presents any analogy to that under considera-

tion; that one is from Somal Land, in Africa, ten degrees north of the equator.

There are, however, some very ancient Chinese inscriptions, dating from about the fourth century before our era, which show a similar device. For this reason, Dr. J. F. Salisbury, of Ohio, has maintained that some connection existed between the mound-builders and the ancient Chinese.

My own opinion, based on a close inspection of the inscribed rock in Licking Co., Ohio, is that the so-called bird-tracks were never intended to represent the footprints of any species of birds, but are conventional signs for *arrows* or *arrow-heads*. My reasons are the following:

In no case are there representations of toes or claws. The centre line is frequently prolonged, passing beyond the junction of the lateral lines, thus giving to the figure a cruciform appearance. More often it is prolonged in the other direction—sometimes to three or four times the length of the lateral lines—presenting an unmistakable picture of a barbed arrow-head on a shaft.

The lateral lines are usually three or four inches in length, while the median line is always longer. The incisions are clean and clear, the edges sharp and singularly firm, betraying a practiced hand and a powerful instrument.

On the supposition that these are intended for arrow-points, I propose for them the name of "cuspidiform petroglyphs." This is descriptive of their actual appearance, and also indicates what they were doubtless designed to represent.

Granting this, we do not have to go far to ascertain the idea which this sign was intended to convey. There can be little doubt but that the arrow signifies a warrior, or some related military conception.

This, in turn, throws light on other points in the archæology of the Ohio region. The inscribed rock at Newark is within about eight miles of a very remarkable series of works between the north fork of Licking River and Raccoon Creek. One of these works is a mighty circular embankment, enclosing an area of thirty acres, now used as the fair grounds of Licking Co. In the midst of this area, headed toward the only entrance, is an effigy mound, of large size, commonly supposed to represent an eagle. At present, however, the alleged eagle has no head, and I could

not see signs that it ever had had one. The figure is, indeed, nothing else than one of these cuspidiform symbols on a gigantic scale. It measures along the central elevation 210 feet, while the lateral lines, called the "wings," branch off about 100 feet from the limits of the central ridge. The point of the arrow is directed precisely to the single gateway or opening of the enclosure.

The inference which the presence of this gigantic delineation of an arrow-head seems to justify, is that this enclosure was once dedicated to military ceremonies of some kind.

The inscribed rock on which my observations were made, is located about six miles from Newark, close to the bank of the Licking River. It is a moderately hard sandstone, much eroded where fully exposed to the weather. The bluff is about thirty feet high, and the summit overhangs the base to such an extent that it furnishes a natural shelter. Many of the inscriptions have thus been preserved with great freshness of outline.

This rock shelter was also extensively used by generations of primitive hunters. Excavations which I made, turned up numerous examples of their work in pottery and stone, and the fragments of the bones of animals used in their repasts.

The only previous examination of this inscription, for archæological purposes, which I have heard of, is one by Dr. Salisbury, in 1859, the notes of which are in MS., in the library of the American Antiquarian Society. A brief memorandum by him, on the subject, was also published in the Report of the Ohio centennial managers in 1876.

NOVEMBER 4.

The President, Dr. LEIDY, in the chair.

Twenty-one persons present.

A paper entitled "On the Behavior of Petrolatum in the Digestive Tract," by N. A. Randolph, M. D., was presented for publication.

Impression of the Figures on a "Meday Stick."—Dr. D. G. BRINTON exhibited a full-sized impression of the figures on a "Meday Stick," obtained from the Pottawattomies, by the eminent antiquary, Dr. E. H. Davis.

These sticks are used as mnemonic aids in repeating the chants in the "Great Medicine Lodge," the principal religious rite of the Algonkins. The present stick is 19 inches long, 2¾ inches wide, and of hard wood. The figures engraved upon it are over 500 in number, chiefly representing plants. These figures are engraved with a knife, but the native name of such sticks points to a more primitive method. It is *massinahican*, literally "a piece of wood marked with fire." The characters inscribed are called *kekiwin*, which means *marks* or *signs*, and from which root are derived the words "to know," "to learn," and "to teach," in many Algonkin dialects.

The characters are of two kinds, notches, and drawings of objects. The notches are believed to indicate the musical time or rhythm of the chant, while the drawings suggest its words. The text of several such songs has been printed. They are usually to obtain success in the chase or restoration to health. The latter appears to be the nature of the present song, judging from the numerous plants depicted.

This Meday stick illustrates an instructive fact constantly lost sight of by antiquaries. The so-called picture-writing of the Algonkin Indians never presented pictures. There is no grouping, shading or pictorial arrangement of the figures. There is no attempt at esthetic effect. The single figures are not connected so as to evoke any artistic sentiment. The intention was wholly apart from this, and where such appears, it is not true Algonkin art.

NOVEMBER 11.

Mr. JOHN H. REDFIELD in the chair.

Thirty-two persons present.

The following papers were presented for publication:—

"Descriptions of New Species of North American Heterocera," by Herman Strecker.

"Some Notes on the Movements of the Andrœcium in Sunflowers," by Dr. Asa Gray.

"Observations on Cinna, with Description of a New Species," by F. Lamson Scribner.

Fired Stones and Prehistoric Implements.—Dr. D. G. BRINTON exhibited specimens of quartzite, sandstone and jasper, which had been subjected to the action of fire, and spoke of their bearing on certain archæological questions.

The most ancient evidence of a knowledge of fire is not the charcoal and ashes of primeval hearths, but stones showing the action of the element. In France they have been found in considerable numbers in the tertiary deposits of Thenay, near Pontlevoy, belonging to the late miocene or early pliocene. In South America, the brothers José and Fiorentino Ameghino have discovered them in a low stratum of the Pampas formation, believed to be referable to the interglacial epoch of the pleistocene.

The effects of fire on stones are quite distinct from those of other agents. They are shown in discoloration, scaling, and peculiar forms of fracture. Quartz becomes cloudy and opaque; jasper loses its fresh yellow hue to turn a dull red, while sandstone forfeits the fresh lustre of its fracture, and shows brown and blackish.

Stones broken by fire present one of two characteristic appearances; the one is called by French archæologists *Craquellage*, the other *Étonnement.* Quartzite illustrates the former, jasper the latter. *Craquellage* presents a plane usually at about right-angles to the plane of cleavage; its surface rough, friable, and full of little pits and rounded eminences—like a face pitted with small-pox, to borrow the simile of Mortillet. *Étonnement* is a splitting by flakes in the lines of percussion cleavage, but distinguishable from the latter by the absence of the bulb of percussion, and the splintering which often attends a blow. The flake and its matrix are perfectly clean at all points of their edges.

Scaling is seen on the surface of sandstones subjected to fire. Small scales are loosened and are detached by exposure, revealing the discolored layers beneath.

It is claimed by some of the French archæologists that the very oldest implements used by man were stones thus fractured by fire. This plan of bringing them to an edge, they say, preceded that of percussion. This does not appear to be the case in America. The implements of the Trenton gravels are of sandstone chiefly; those of the interglacial of the upper Mississippi are of quartzite, neither of which fractures by *Étonnement.* Whether the later residents of our soil ever used fire to aid their

art-production in flint and jasper is uncertain. The speaker had seen no specimens that conclusively showed that they did.

Cutaneous Absorption of Nicotine.—Dr. N. A. RANDOLPH described the results of a series of experiments performed by Mr. Samuel G. Dixon and himself, relative to the absorption of nicotine by the uninjured healthy skin of the living rabbit. In these experiments only rabbits of ascertained good health were used. The fur of the abdomen was carefully clipped (not shaved); sufficient time, usually seven days, being allowed to intervene between this operation and the application of the drug to the skin; thus permitting any slight scratch made at this time to fully heal. The absence of cutaneous lesion was further confirmed by close examination under a strong hand-magnifier. The drug was then applied to the skin, no friction being used. In order to preclude the possibility of its vaporization and subsequent absorption by the lung surface, the nicotine was placed upon an adhesive plaster, the backing of which was made of sheet rubber. The plaster, with the drug in its centre, was then applied in the open air, on a windy day. Different doses were applied; thus, in one case, one drop of nicotine applied to the skin, caused death in five hours and eleven minutes. In each of three cases a similar application of ten drops was fatal in respectively one hundred and nine minutes, twenty-eight minutes, and thirty-six minutes. In the fifth case, a similar application of fifteen drops of nicotine caused death in twenty-eight minutes.

Of the ante-mortem symptoms, contraction of the pupil was *constant*, and often appeared very quickly. Other prominent symptoms were great trembling, with subsequent loss of muscular power in the extremities. In one case, actual convulsions were noted, and in others, coldness of the skin and increased lachrymal and nasal secretion. Immediately upon the death of two of the animals (after the ten- and fifteen-drop doses respectively), blood was removed, defibrinated, and tested with mercuric chloride for the presence of nicotine in the manner detailed by Wormley ("Micro-Chemistry of Poisons"). In each of these two instances, characteristic groups of crystals were found upon microscopic examination of the extract from the blood.

The following was ordered to be printed:—

ON THE BEHAVIOR OF PETROLATUM IN THE DIGESTIVE TRACT.

BY N. A. RANDOLPH, M. D.

The mixture of hydrocarbons, recognized by the pharmacist under the name of petrolatum, and popularly used under the commercial names of cosmoline or vaseline, presents on superficial inspection few points of difference from some of the organic fats of the same consistency. Close examination reveals differences, both in physical properties and in chemical constitution, between the bodies just compared. One point of difference, which I have as yet been unable to find recorded, lies in the respective behavior of these two groups, when in contact with the absorbent surfaces of the digestive tract. Thus, while the organic fats, as ordinarily taken in food, are readily and almost completely absorbed, this soft paraffin is entirely rejected, and found unchanged in the feces.

During eight days, I took daily one-half ounce of commercial vaseline, in addition to my regular diet. Digestion was in no wise altered, and no appreciable results ensued. Later, two healthy adults each received, in the course of forty-eight hours, one ounce of vaseline. Their alvine dejections for three days from the beginning of this observation were collected and dried, and, at the suggestion of Dr. John Marshall, of the University of Pennsylvania, extracted with petroleum ether. Making a slight allowance for incompleteness in extraction, the vaseline ingested was, in each case, recovered in its totality, showing that it had passed through the economy unchanged and unabsorbed.

There are some important medical applications of these facts, the discussion of which would be out of place here, and which I reserve for further experiment; but the following deductions appear permissible, and are of strictly biological interest.

I. Pure petrolatum, while entirely unirritating to the digestive tract, is valueless as a food-stuff.

II. The results of the experiments here described lend support to the theory that oleaginous matters are dependent, for their absorption, not upon mechanical, but upon vital activities, and that in such absorption the selective power of the protoplasm of the intestinal epithelium is manifested.

NOVEMBER 18.

The President, Dr. LEIDY, in the chair.

Thirty-seven persons present.

The deaths of Eli K. Price, C. P. Bayard and J. Edwards Farnum, members, were announced.

Urnatella gracilis.—Prof. LEIDY remarked that Mr. E. Potts had given to him, in October, 1883, a fragment of a tree-branch on which were many groups of *Urnatella*. The fragment, three inches by one-third of an inch, was obtained in the fore-bay at Fairmount. Around its middle, for about an inch in length, there were thirty separate groups of *Urnatella*, in nearly all consisting each of two stems, of unequal length, and devoid of terminal polyps. The stems diverged and curved downward and were quiescent, but were evidently living, as they exhibited slight sensitiveness to disturbance. The specimen was placed in an aquarium, exposed to the north light of a window, and in this position, at the moderate temperature of usual living-rooms, was kept during the winter. In March the stems were observed all to have developed polyps at the distal end, in which condition they continue at the present time (April). Most stems are terminated by a single polyp, but a few exhibit a smaller polyp, supported on a cylindrical joint springing from the antepenultimate joint of the stem, including the terminal polyp. The stems are quite irritable and bend in graceful curves from each other on the slightest disturbance. The longer stems even hang their heads in a single spiral turn. The longest stems consist of a dozen joints and measure about the one-eighth of an inch. The shortest stems exhibit one-third the number of joints. The stems appear alternately white and black, the former color corresponding with the thicker portion of the joints, the latter with the constricted portions. Many of the mature joints exhibit traces of the cup-like remains of attachment of branches, in most cases on one side only.

These specimens appear to indicate that, as in the other fresh-water polyzoa, the polyps die on the approach of winter, but the headless stems appear to remain, securely anchored, and ready to reproduce the polyps in the spring. If portions of the stems are destroyed, the remaining joints are capable of reproducing the polyps, commonly from the summit of the terminal joint. Branches usually spring from the last one or two joints, newly produced from that which immediately supports the terminal polyp. Specimens also show that heads may start laterally from old or mature joints. Thus the latter appear to serve as the statoblasts of other fresh-water polyzoa, but ordinarily they do not become isolated from one another. As no specimens have been seen with stems consisting of more than a dozen joints, perhaps after reaching this condition, the polyps become detached, to establish new groups.

The following were ordered to be printed ;—

DESCRIPTIONS OF NEW SPECIES OF NORTH AMERICAN HETEROCERA.

BY HERMAN STRECKER.

Smerinthus astarte.

♂ expands 3 inches; head brown; thorax above dark brown, patagiæ whitish gray; abdomen grayish brown above, more ashen beneath.

Primaries dentated exteriorly, but not as deeply notched as in *Cerysii*, but more so than *Opthalmicus*. Pointed apically more as in the latter, not so squarely cut off as in *Cerysii*. Secondaries larger in proportion and more evenly cut on outer edge.

Upper surface. Ground-color whitish gray, variegated with brownish shades and bands as in *Cerysii* and *Opthalmicus*, not as much broken and zigzag as in the first, neither as clearly defined as in the last; the white discal lune and accompanying line, extending half way along the median nervure, are boldly defined, as in *Cerysii*.

Secondaries rosy with white at inner margin, grayish at costa and inclined to brownish at exterior margin. An anal ocellus black, with a bisected blue ring enclosing large black centre. Fringe white.

Under surface resembles closely that of the two allied species alluded to.

Taken, in several examples, by Mr. David Bruce, near Denver, Colorado.

This remarkable insect, whether a good species or a variety of *Opthalmicus* or *Cerysii*, it seems impossible to determine; geographically considered one might be led to the conclusion that it was a link between the two, and to compare it placed aside of examples of either it is an impossibility to decide to which it belongs; the strongest point (and not a very strong one either) is the bisected blue ring of the anal ocellus, which would denote a closer affinity to *Cerysii*. Were it a hybrid, the product of the aforementioned two species it could not be more difficult to draw the line of separation, or to say to which species (or form?) it was most closely allied. Future captures in various localities may eventually lead to the knowledge that all three, *Opthalmicus*, *Astarte* and *Cerysii* are but forms of one species: to which belief I am most strongly inclined at the present writing.

Ecpantheria cæca.

♂ expands $1\frac{5}{8}$ inches; head white above, black in front and

beneath; collar white, with two black lines or marks; patagiæ white, with a black band; thorax above white with a black central band from collar to abdomen; abdomen above whitish near the thorax, rest blackish, beneath white, a row of four or five (body a little abraded at sides) black spots laterally, and five ventrally; legs black, furred inwardly with white.

Primaries, upper surface, white with black spots, arranged much in the same order and number as in *Scribonia*, but instead of being circular or oval as in that species, they are parallelogrammic, square or wedge-shaped, and are not black rings encircling a white spot, but are all black blind eyes.

Secondaries white with some scattered brown marks at outer margin, heaviest near apical angle, and a brown discal spot.

Hab.—Colorado.

There is on this species none of the blue sheen so conspicuous on *Scribonia*, but the marks are all black or brownish black, and the whole insect calls up the idea very strongly of *Arctia Spectabilis* Tausch., from Russia.

Spilosoma niobe.

Expands $1\frac{1}{4}$ inches; head white, palpi yellow, terminally black; thorax white; abdomen above white, with a row of five large dorsal spots, sides yellowish, with two rows of black spots; some allowance must be made for the description of the abdomen, as it was compressed and somewhat rubbed. Legs yellow, tarsi ringed with black and white. Antennæ wanting on the single example whence this description is drawn.

Upper surface. Primaries white, with all nervures and nervules heavily bordered on both sides with brown; this brown is not dark and is much of the color of coffee with a somewhat undue amount of milk in it, in some lights it has a slight bronzy appearance.

Secondaries white, the nervules on costal half of wing towards apex shaded with same brown as superiors, but not as heavily.

Under surface nearly as above.

One example taken in Florida, some years since, by Mr. A. Bolter, from whom I obtained it.

Harpyia albicoma.

♂ ♀ size and form of *Borealis*, *Bicuspis*, *Bifida*, etc. Head and collar pure white; thorax above dark gray and white; abdomen above gray heavily clothed with white hair. Body beneath white.

Primaries, upper surface white with a dark steel-gray band crossing the wing about one-third from base, this band is chevron-shaped, narrowest in the middle and widening to double its width towards the costal and interior margins; in some examples divided entirely in the middle. Interior to this band is a transverse row of four dots of same color, and a single dot on costal nervure near the shoulder. Between the outer and median space of wing are three irregular broken gray lines, the outermost of which on the costal half joined by a broad wedge-shaped gray mark. A dark discal dot and dark point at termination of nervules.

Secondaries white, dark discal mark and dark dot at end of each nervule.

Under surface white, with markings of upper side more or less faintly reproduced, and the addition of a gray transverse line across the middle of secondaries.

Described from examples taken, in summer of 1883, by Mr. David Bruce, in mountains of Colorado.

This species comes nearest to the European *Bicuspis* Bkh., in the latter the dark band and marks are much heavier and more decided, but their arrangement is nearly the same.

Mr. Bruce took, this last season, also in Colorado, examples of *Cinerea* Wlk., which do not differ from those taken in Pennsylvania, New Jersey and New York.

Lophopteryx elegans.

♂. Form of *Carmelita*, which appears to be its nearest ally. Expands 2 inches. Head fawn-color; thorax above slate-gray, abdomen fawn, shading into brown towards the thorax, beneath whitish.

Primaries chocolate-brown, darkest towards base and along the costa, and shading into ashen along the exterior margin, a streak or line of pure silvery white along submedian nervule, starting at base and extending one-third the length of the inner margin; the narrow space between this line and inner margin paler brown, inclining to ochre. Two short, dark, subapical longitudinal lines; exterior margin with a fine dark line.

Secondaries white, with dark anal patch cut with a fine white line, as in other species.

Under surface. Primaries hoary gray, with brownish on costa and broad indistinct submarginal shade of same color parallel

with the exterior margin. Secondaries white, edged with brown on costa, and on exterior margin near and at anal angle.

From one ♂ received from Mr. Fish, taken in the vicinity of Oldtown, in the State of Maine.

In the old collection of Trexler, which came into my possession about twenty years since, was an example, in poor condition, which I consider identical with the above; recently I have received several examples, males, from Mr. David Bruce, who took them in Colorado. These I can consider nothing more than a variety of the above; the only difference being in the color of head and primaries, which in Trexler's and these Colorado examples is of a slate-gray, and not brownish as in the Maine examples; to prevent, however, the misfortune of this variety being described as a new species, I would designate it as *L. Elegans* var. *Grisea.*

Lasiocampa gargamelle.

♂ ♀ in form and general resemblance allied to *L. Pini.*

♂ expands about $2\frac{1}{4}$ inches. Head and thorax brown, intermixed with gray; abdomen brown.

Primaries obscure grayish, caused by an admixture of white and brown hair and scales; the basal third darker and more brownish; there is a tolerably broad outer margin wherein the brownish shade also prevails, this is separated from the paler, more ashen median space by an irregular zigzag brown line; there are also faint indications of two lines crossing the wing, one subbasal and grayish, the other half-way between the discal spot and the brown zigzag line, and scarcely perceptible; discal spot small, round and pure white.

Secondaries brown, with a paler, somewhat ochraceous mesial band, fringe white.

Under surface. All wings brown, with a common, rather broad pale, ochraceous median band.

♀ expands $3\frac{1}{4}$–$3\frac{1}{2}$ inches. Color has more of the brownish prevailing. Character of the markings as in male, but less strongly defined; the median band of secondaries above, and all bands beneath, narrower than in the other sex.

Hab.—Arizona.

By American authors this insect would be placed in Packard's genus *Gloveria*, the type of which was *Gloveria Arizonensis;* there is, however, nothing by which it can be separated from *Lasiocampa* Latr. (*Gastropacha* O.).

NOTES ON THE MOVEMENTS OF THE ANDRŒCIUM IN SUNFLOWERS.

BY DR. ASA GRAY.

My attention was called to this subject by some observations made by Professor Meehan, the substance of which is now printed in the "Proceedings of the Academy of Natural Sciences," pp. 200, 201, under date of July 15 of this year. My own study of the subject was necessarily desultory and interrupted, and mainly too late in the season for the most satisfactory investigation. My object in sending this communication to the Academy, at this time, is, in the first place, to thank Mr. Meehan for calling attention to a very obvious fact, which I had entirely overlooked, and which those botanists (such as the late Hermann Müller), who have particularly attended to the adaptations for fertilization in Compositæ, were seemingly not aware of. The fact referred to, is the retraction of the anther-tube in *Helianthus* (and so, presumably, in its near allies), somewhat in the manner of *Centaurea* and the Thistle tribe generally. In the second place, I wish to maintain that this retraction in the sunflower is the result of automatic or irritable shortening of the filaments, and not of the "elasticity of the filaments." In other words, that those organs act in Sunflowers as they have for a long time been known to do in the Thistle tribe, but with some difference. If I rightly understand Professor Meehan's account, he supposes that the anther-tube is carried up to its full height by the elongation of the style within, its stigmatic apex pushing against the conniving anther-appendages which close the orifice of the tube, and so stretching the filaments; and that the elastic shortening of the filaments pulls down the anther-tube when the style has overcome this obstacle and protruded. If this were so, the stamen-tube should be drawn down at once upon overcoming the resistance. It is easy to test this, by snipping off the anther-tips by sharp scissors. But when I did this, no retraction followed. Moreover, on splitting down anther-tubes at various stages of their growth, I found that only at the last, and after the anther-tube had attained its full height, was the tip of the style in contact with the anther-tips. Prof. Meehan's idea that "the extension of the staminal tube is evidently mechanical, and is due solely to the upward growth of the stigma, which, partly it seems by the incurved points of the stamens, and partly perhaps by the expansion of the arms of the

pistil, is able to carry up the tube with it," so that when the resistance is removed, "the elastic stamens [filaments] draw the tube down again," must therefore be given up. The expansion of the arms of the style is not concerned in the process, for this does not commence until after complete protrusion.

As the filaments in the Thistle tribe are sensitive to the touch, in some Centaureas strikingly so; as these are not stretched in *Centaurea*, but are usually bowed outwardly, and as they contract upon the touch of a bristle or of a visiting insect, the first question is whether the same may be the case, in some degree, in Sunflowers. My essays to determine this were made too late in the season to be decisive. But in some flowers, on touching two adjacent filaments with a bristle thrust into one side of the corolla, the column moved promptly toward that side, moving through fifteen or twenty minutes of arc, very much as it will in a *Centaurea*. I did not succeed in causing the five filaments to act together, so as to produce any observable retraction. That this retraction normally takes place without extraneous irritation, is certain, commencing and commonly being completed on the second day after full anthesis; and equally in flowers shielded from the visits of insects.

In Sunflower-heads taken into a room and kept from bees, the pollen, pushed out of the tube through the chinks between the anther-tips, or later borne on the brush of the (as yet) unopened style-branches, is borne aloft, exposed to the humblebees which in the garden freely visit them. Prof. Meehan states that "honey-gatherers seldom resort to them," but I find that in our grounds these were much the most frequent visitors. These were passing from head to head and from plant to plant, inserting their proboscis into the corolla-tubes in succession, beginning at the circumference with the older flowers having expanded and receptive stigmas, and proceeding to the pollen-loaded ones within. It is easy to see that pollen is abundantly transported from one head and one plant to another, and that it is carried from flowers which could not possibly be self-fertilized until the next day, and unlikely to be so then, to those the expanded stigmas of which are only then receptive. Prof. Meehan "may say emphatically that these arrangements favor self-fertilization," but that is not the conclusion which I should draw from his own illustrations any more than from my own.

OBSERVATIONS ON THE GENUS CINNA, WITH DESCRIPTION OF A NEW SPECIES.

BY F. LAMSON SCRIBNER.

Two species of *Cinna*,[1] common to the northern regions of both the old and the new world, have long been recognized. They are *C. arundinacea* L. and *C. pendula* Trin. The latter, the more common of the two, has been reduced to a variety of the first-named, by some authors; but, aside from a marked diversity in habit, there are important differences in the characters of the spikelets quite sufficient to warrant a specific distinction. In *C. arundinacea* the spikelets are larger, firmer in texture, more strongly scabrous, more prominently nerved and there is a decided inequality in the outer or empty glumes, while in *C. pendula* these glumes are equal or nearly so. In both the floret is stipitate, or raised on a short stalk above the insertion of the empty glumes; in other words, there is a slight elongation of the axis of the spikelet between the two empty glumes and the flowering glume. Mr. Bentham, in his "Notes on Gramineæ," states that in *C. arundinacea* there is frequently a continuation of the rhachilla in the form of a short naked pedicel behind the palea: a character, he adds, that he has never seen in *C. pendula*. In my own studies, I have found this prolongation of the rhachilla, a common, not constant, character in both species. I have observed it in the spikelets of *C. pendula* from Maine and from Oregon; in fact, my own observations would lead me to say that it appears more frequently in that species than in *C. arundinacea.*

In regard to the variations in these two species something may be said. *C. arundinacea* exhibits considerable diversity in the size and diffuseness of its panicle and the spikelets, which range from a little over two to nearly three lines in length, vary in color from pale green to dark purple, but those characters mentioned above as distinguishing this species from *C. pendula*, remain constant. There is greater variation of the panicle in *C. pendula*, and also in the size of the spikelets; these, however, never reach two lines in length, and, although the empty glumes

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[1] *Cinna macroura* Kth. and other grasses that have been placed in this genus, are now referred to *Epicampes* or *Deyeuxia.*

differ considerably as to width, acuteness and in the presence or absence of the lateral nerves in the second one, they are always very nearly equal in length. In the here-proposed new variety—var. *glomerula*, from Washington Terr., Frank Tweedy, collector—the equal, one-nerved empty glumes are very narrow, acuminate-pointed and scarcely more than a line in length. The spikelets in this variety are arranged in dense clusters or glomerules along the extremities of the branches of the very diffuse panicle.

A species of *Cinna*—No. 6090 Bolander, N. 22 of the small collection—came into my hands for examination several years ago, and my note at that time was that it was distinct from *Cinna arundinacea*, var. *pendula*, of Gray's Manual, under which name it was distributed. The past season my attention was again called to this grass by seeing some notes upon it in Dr. Gray's Herbarium at Cambridge, made, if I remember rightly, by Mr. Bentham, suggesting the probability of its being a new species. After careful comparisons with *Cinna arundinacea* and *C. pendula*, I am convinced that this suggestion is correct, and propose that the species be named *Cinna Bolanderi*, recognizing the fact that Mr. Bolander, so far as I know, has alone collected it.

Cinna Bolanderi.

Spikelets two and a half lines long, empty glumes broadly lanceolate, the upper one three-nerved, subequal, as long as the floret, which is scarcely, if at all, stipitate; culm stout, seven feet high (in Bolander's specimen), smooth; sheathes strongly striate, the lower smooth, the upper ones scabrous. Leaves firm in texture, prominently striate and scabrous on both sides, those of the middle portion of the culm one to two feet long, and three-quarters of an inch wide, all gradually tapering to a sharp point. Panicle eighteen inches long, loose and widely spreading.

From the characters above cited, the following synopsis may be made of the species in the genus:

Empty glumes unequal.
Spikelets $2\frac{1}{4}$ to 3 lines long. *C. arundinacea* L. 1.
Empty glumes equal or nearly so.
Spikelet less than 2 lines long, floret stipitate.
C. pendula Trin. 2.
Spikelet more than 2 lines long, floret apparently sessile.
C. Bolanderi Scribn. 3.

EXPLANATION OF PLATE VII.

FIG. 1.—Spikelet of *Cinna pendula* Trin.

FIG. 2.—Same with empty glumes removed, and the elongated rhachilla behind the palea brought forward into view.

FIG. 3.—Spikelet of *C. pendula*, var. *glomerula*.

FIG. 4.—Spikelet of *C. Bolanderi* Scribn.

FIG. 5.—Same with empty glumes removed.

FIG. 6.—Spikelet of *C. arundinacea* L.

FIG. 7.—A larger spikelet of same.

FIG. 8.—A spikelet of *C. arundinacea* with empty glumes spread out, and the continuation of the rhachilla behind the palea brought into view.

FIG. 9.—Spikelet of *C. arundinacea*, empty glumes removed; *a*, the stipe.

NOVEMBER 25.

Rev. H. C. McCook, D. D., Vice-President, in the chair.

Forty-one persons present.

Embryology of Fulgur, etc.—Mr. JOHN FORD reported the finding of capsules of *Fulgur carica*, containing living embryos, near South Atlantic City, on November 16, 1884.

As he had already secured live specimens in December, 1883, and in each of the six months following, this would prove the deposition of capsules by the species mentioned during the largest part of the year, instead of in the spring months only, as was formerly supposed. Living embryos of *F. canaliculata* were also obtained monthly, during the same period.

About one-half of the original amount of albumen in those found on the 16th, had been utilized by the young mollusks; a somewhat reasonable indication that they were near the middle stage of embryotic growth.

In further support of this probability, it was noticed that the delicate cilia which characterize the animal in its earlier stages, were much shortened, and the shells less transparent.

On the other hand, the thin circular membranes upon the edges of the capsules, through which the matured embryos finally escape, were still unbroken, and in much the same condition as when first exposed; thus proving that the young mollusks were as yet unprepared for a new stage of existence.

Several other strings of capsules, including some of *F. canaliculata*, were secured on the same occasion, but exposure to the sun for a day or two, had killed the embryos.

At the same locality were discovered two species of living Pholades, *P. crispata* Linn. and *P. truncata* Say, also a fine colony of living *Littorina irrorata* Say; all of these species being new, it is believed, to that part of the coast.

It is probable that the billet of wood in which the Pholades were found, had drifted from some distant locality, as there do not appear to be any conditions favorable to their existence between Brigantine Inlet and Great Egg Harbor Bay.

In regard to the habitat of the Littorina there could be no doubt whatever, as they were present in large numbers, and in a flourishing condition, although dwelling literally upon the sand, instead of on broken rock or pieces of timber, where the species is usually found. It is southern in distribution, rarely occurring north of the mouth of Chesapeake Bay.

An Unfamiliar Rhizopod.—Mr. EDW. POTTS remarked that he had observed, upon a scale of mica schist about one square inch in surface, clipped from a stone picked up near the eastern margin

of the Schuylkill River above the Spring Garden Water Works, Philadelphia, a dozen or more rhizopods of varying sizes, apparently quite motionless, and, by direct illumination, resembling the familiar forms of *Actinophrys* or *Actinosphœrium*.

When removed to a compressorium and examined by transmitted light, however, entirely different characteristics were discovered. An outer surface or test was composed of infinite numbers of minute, smooth, curved spicules, gathered somewhat irregularly into radial, acuminate, conical groups, giving to the mass very nearly the appearance of the seed-balls of the sweet-gum tree, *Liquidamber styraciflua*. Within the cavity of this spicular envelope, was seen a spherical protoplasmic body, perhaps one-third of the diameter of the outer test, composed of a multitude of granuliferous cells and a single non-central nucleus. From this "body," many pseudopodal filaments were thrown out through the interstices amongst the spicules, in direct radial lines, to a distance exceeding the height of the spicular cones. They were not constant, however, and at intervals none could be discovered. To test the character of the spiculæ, one individual was treated with strong nitric acid and afterwards mounted in balsam. The protoplasmic body was of course destroyed, but the spicules remained, showing them to be, in all probability, composed of siliceous material.

The speaker was at first inclined to class this rhizopod with the genus *Acanthocystis*, but further examination convinced him that it was more probably allied to *Raphidiophrys*, and a still further examination of F. E. Schultze's papers on the Rhizopodæ warrants its complete identification with his *Raphidiophrys pallida*. In his recent monograph upon this subject, Professor Leidy has referred to this species his sketch of a single individual likewise collected, some years ago, in the Schuylkill River. These appear to be the only instances in which it has been identified on this continent. Its habit of lying close against a supporting surface, seldom or never freely swimming, easily distinguishes it from other familiar Heliozoans.

Note on the Intelligence of a Cricket parasitised by a Gordius.—Dr. Henry C. McCook said that some remarks upon the habits of the cricket published by him, had called forth an interesting communication from Mrs. C. W. Conger, of Groton, New York, the substance of which is as follows:—

"Some twenty-four years ago, my husband and myself took possession of a large old frame house on a farm which was a homestead for the largest, blackest, and most musical of the cricket kind. Early in the fall, I began to be annoyed by finding one or more hair snakes in the water-pail. Though I knew that there positively was nothing of the kind in the pail when it came in, yet a few minutes or an hour generally provided us with a more or less lively specimen. I had a horror of them, because

of the dread lest the children should imbibe one with their frequent nips of the water, so I sat down, one warm afternoon, to watch the pail, to try to learn how the snakes came. In about ten minutes I saw a particularly plethoric cricket mount upon the edge of the pail, and, after some uneasy movements, bring the tip of the abdomen just beneath the water, and, with a few violent throes, expel a black mass, which fell slowly through the water, and before it reached the bottom resolved itself into one of the worms. The cricket seemed exhausted by the horrid birth, and did not find strength to draw itself up on the edge of the pail for about eight minutes, and when it finally did so, it tumbled to the floor and crawled off in a very rheumatic manner. After this discovery, we used to amuse leisure hours by watching like operations until frost killed the crickets. I sometimes would crush large crickets, generally with the result that a tightly-coiled snake would be thrust out of a rupture just above the tip of the abdomen; but, whether the snake was not sufficiently developed, or because of its needing water rather than air to vitalize it, none of the snakes so produced showed any signs of life."

The water snake alluded to is, of course, a species of our common *Gordius*, the same probably as that described, a number of years ago, by our distinguished President, Prof. Jos. Leidy. The fact that this animal is parasitic within the grasshopper, the speaker had himself observed; it has been said also to be parasitic within spiders, and doubtless has for its host many of the orthopterous genera. The point of greatest interest in the letter, Dr. McCook thought, is the fact that the crickets had evidently learned that the parasite infesting them required the water in order to make its egress, and had deliberately sought the suitable place and assumed the proper position (by inserting the abdomen beneath the surface of the water), necessary to insure that egress. It is a curious physiological question: how did the cricket obtain this knowledge? And, the knowledge having been obtained, the cricket's subsequent behavior presents an interesting fact in the study of insect intelligence.

A New Parasitic Insect upon Spider Eggs.—Dr. McCook further stated that he had received, through Mr. F. M. Webster (October, 1884), from Oxford, Indiana, a parasitised spider cocoon (evidently of some saltigrade species), apparently that of *Attus audax*. The cocoon contained within the outer flossy case about eighty cells and a number of mature black hymenopterous insects, about one-eighth of an inch long. The cells were ovoid, gray, blackish at the closed end, probably from excretions of the enclosed larvæ. One end was cut open, showing where the insect had escaped. With the exception of a few hard, dried, yellowish brown examples, all the eggs of the spider had disappeared. The specimens were sent to Mr. L. O. Howard, of the Bureau of

Entomology, Department of Agriculture, Washington, D. C., who judged them, after a cursory examination, to be Proctotrupids, belonging to the sub-family Sceliominæ, and seeming to form an entirely new genus. Thus appears to be added one more to the parasitic enemies of our spider fauna.

Rufus Sargent and W. Henry Grant were elected members.

The following were elected correspondents:—John Ball, of London; William Carruthers, of London; Rud. Leuckart, of Leipzig; Anton Dohrn, of Naples; A. Grenacher, of Halle i. S.; Alex. Götte, of Rostock i. M.; and Ludwig Will, of Rostock i. M.

DECEMBER 2.

The President, Dr. Jos. LEIDY, in the chair.

Thirty persons present.

DECEMBER 9.

Mr. J. H. REDFIELD in the chair.

Thirty-one persons present.

On Derivation in Pinus edulis and Pinus monophylla.—At the meeting of the Botanical Section, on December 8, Mr. THOMAS MEEHAN called attention to some dried specimens of *Pinus monophylla* on the table, which were received in a fresh condition, a few months ago, from Mrs. Lewers, of Franktown, Nevada. At that time the phyllodes which took the place of the real leaves, were all monophyllous. In drying, several had opened in some specimens, and others readily separated by a little aid, showing that the species might have been two-leaved, but for some inability in the early stages of development to separate them. This monophyllous species was closely allied to *Pinus edulis*, which was confined to the Rocky Mountains; the monophyllous species being the form that prevailed further west. But in a small tree of *P. edulis*, growing in a deep ravine in Queen Cañon, in the Rocky Mountains, he had found on the same tree monophyllous, diphyllous, and triphyllous phyllodes, and there could not possibly be any doubt that the species were of one origin. The case was one worthy of note, because it had been charged that there was no actual evidence of the truth of the doctrine of derivation. Generally when such evidences as these were offered, the objector was prepared to abandon his belief in the specific distinctness of the forms, rather than to grant that two distinct species had been developed from one parent, and even in the case of these species

there were some who regarded one as but a variety of the other. But there were other distinctions: The cones were not quite the same, and the seeds being very different in size and outline, so that one could readily separate the seeds if mixed together. There was in fact a whole series of distinctions, fully as great as we could find in many well-recognized species, and which fully entitled the two forms to full specific rank; though in the face of the evident facts that they are derivations of one original parentage. Indeed, it was well known that when a plant changed its character in one respect, it must do so in others; plants in some climates annual, would become perennial or suffrutescent in others. The cotton-plant was a familiar example. In such cases the foliage and other characters varied from those connected with the annual form, and from this fact some botanists had regarded *Gossypium herbaceum* and *Gossypium arboreum* as distinct species. In the case of these two species of *Pinus*, the one which could not develop its phyllodes with two separate individuals, would of necessity present some peculiarities in the scales of the cone, as these were, morphologically, but transformed phyllodes. Under morphological laws, that which affected the leaves ought to affect the carpels or other parts of fructification which were modified from them.

The true position of the species in development is that *Pinus edulis* had the highest rank. In raising both species from seed there was no difference whatever between the seedlings during the first season. In these young and delicate plants, true leaves were perfectly developed; these were flat, linear lanceolate, and of a deep glaucous hue. *Pinus edulis* assumed stout vigorous branches the second year; then the true leaves were suppressed, a portion only being adnate with the stem forming a sort of cushion, or as bud-scales, or bracts under the scales of the cone, from the axis of which the phyllodes—secondary leaves, or bundles of leaves of some authors—spring. In *Pinus monophylla* only a few branches made phyllodes the second year, and he had plants which were ten years old from the seed, which continued to bear branches with true leaves almost equally with those bearing phyllodia. The monophyllous branches were never as strong as those from *Pinus edulis*, and in ten years a plant of *Pinus edulis* would be double the size of *Pinus monophylla*. Assuming, as we might, that the two had one parentage, we saw that the one had less vigor of growth; it retained more of its juvenile characteristics, and retained them longer than the other; and it never reached the power of development that *Pinus edulis* had attained. We may say, with confidence, that *Pinus monophylla* sprung from the same parentage as *Pinus edulis*, and became permanently different throughout, being subjected to conditions unfavorable to a full development. It would appear that the soil and climate of Nevada were not favorable to the usual development of *Pinus edulis*, and hence, through the long course

of ages, the suppressed features that characterized full maturity in the original, became, under the law of heredity, permanent ones.

It was not often that we had such clear evidence of the unity of origin in two certainly distinct species, and as supporting the modern ideas of evolution, the case was worthy of being placed on record.

DECEMBER 16.

The President, Dr. JOS. LEIDY, in the chair.

Twenty-nine persons present.

A paper, entitled "Homologies of the Vertebrate Crystalline Lens," by Benjamin Sharp, M. D., was presented for publication.

The death of Robt. L. Weber, M. D., a member, was announced.

Immediate Influence of Pollen on Fruit.—Mr. THOMAS MEEHAN directed attention to an ear of Indian corn on the table, sent by Mr. Burnett Landreth, which had nearly all one side with brownish-red grain, the other side creamy white, which was the normal color of the variety. Usually the intermixture of colors which occasionally occurred in an ear of corn, is attributed to cross-fertilization. It is apparent that this could not be the case in this instance. The whole solid block is colored, and, at the edge of the colored mass only half a grain would be colored in some instances. The coloring influence had evidently spread from some central point, quite independent of any single grain, and had spread from grain to grain through the receptacle, until the coloring material was exhausted. In cross-fertilization from the entangled position of the silk-like pistils, no such regularity of coloring in adjoining grains could occur. On reflection we may understand that at times color in corn must come from causes independent of cross-fertilization, as the departure in the first instance from one color must be from an innate power to vary in color, independently of any pollinating influence.

The facts are interesting as bearing on many problems as yet not wholly solved. Much has been said about the changes in nature being by slow modifications through long ages, but we have frequent instances of sudden leaps. There are no gradations between the colors of these grains. Again, it is in dispute how far cross-fertilization influences the seed. Generally, no immediate influence is conceded; we have to wait till the seed grows, and we can examine the new plant to ascertain the potency of the several parents. So far, corn has been the chief, and almost the only, evidence that the seed or its surroundings are immediately affected; but recently statements have been made that the receptacle in the strawberry—what we know in every-day life as the

strawberry—is similarly influenced. There are some varieties wholly pistillate, and it is claimed that when pollen is applied from other varieties, the resultant fruit is that of the male parent. It is of great practical importance that such a question should be decided by undoubted facts. Experience in other directions does not confirm these views.

The *Mitchella repens* is really a diœcious plant. Many years ago he found one plant with white berries, and removed some portion to his own grounds, where, isolated from others, it produces no fruit. In its native location it bears white berries freely, though the pollen is from the original scarlet-berried forms. Mr. Jackson Dawson had given him a similar case on Professor Sargent's grounds, where a white-berried *Prinos verticillatus* is produced, though it must have pollen from the original red-berried form. Other illustrations were referred to. To those who looked for regularity of rule in these cases, and in the light of the specimen of corn before the meeting, there might be a doubt whether the variation in corn, often attributed to cross-fertilization, may not, in some cases, result from an innate power to vary. It did not really follow that the rule should be uniform, for those who had experience in hybridizing knew how variable were the results, even from the seed of a single flower. Parkman had obtained, in lilies, seedlings so exactly like the female parent, that only for the remarkable form from the same seed-vessel, known as *Lilium Parkmani*, it might have been doubted if some mistake as to the use of foreign pollen had not been made. If so little influence could occasionally be found at a remote end of the line, we may reasonably look for an immediate influence at the nearer end in some exceptional cases. But there appeared to be no carefully conducted experiments on corn recorded anywhere, though the belief in the immediate influence of strange pollen is a reasonable one so far as general observation goes. It seemed, however, to him, with the specimen of innate variation in corn before us, more careful experiments with corn and other things are desirable.

DECEMBER 23.

The President, Dr. JOSEPH LEIDY, in the chair.

Thirty-two persons present.

The following papers were presented for publication:—

"On a Remarkable Exposure of Columnar Trap near Orange, N. J.," by Prof. Angelo Heilprin.

"Note on Some New Foraminifera from the Nummulitic Formation," by Prof. Angelo Heilprin.

"A Review of the American Species of Stromateidæ," by Morton W. Fordice.

A Glacial Pebble.—Dr. DANIEL G. BRINTON exhibited a supposed stone implement, obtained from the glacial drift in Butler County, Ohio, sent to him by its finder, for examination. He observed that, while there is no inherent improbability in such a discovery—as it is quite likely that man, or at least an implement-making animal, existed on this continent during the glacial epoch—this particular specimen does not offer convincing evidence that it is a work of art. It is a polished stone, resembling an axe. Both these facts are against it. The axe type appears late in the stone age, and nowhere, except in California, have geologists gone so far as to put the age of polished stone so far back in time as the tertiary period. In that enterprising State, the men of science claim that, not merely fine, but the very finest, examples of polished stone ever found in either continent are exhumed, *in situ originali*, from gravels of the pliocene and post-pliocene epochs (Foster, "Prehistoric Races of America," p. 55). This is in direct conflict with everything yet known of the older stone age elsewhere.

The present specimen illustrated anew how natural forces occasionally simulate in their products the results of hand-work. The criteria of the latter are, however, well-ascertained, and by observing them one can scarcely be deceived in examining any series of examples.

DECEMBER 30.

MR. GEORGE W. TRYON, JR., in the chair.

Forty-one persons present.

The following were ordered to be printed:—

HOMOLOGIES OF THE VERTEBRATE CRYSTALLINE LENS.[1]

BY BENJAMIN SHARP, M. D., PH. D.

I cannot better introduce my subject than by quoting the following passage from Chas. Darwin: "To suppose that the eye, with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection seems, I freely confess, absurd in the highest possible degree. Yet reason tells me that, if numerous gradations from a perfect and complex eye to one very imperfect and simple, each grade being useful to its possessor, can be shown to exist; if, further, the eye does vary ever so slightly, and the variations be inherited, which is certainly the case; and, if any variation or modification in the organ be ever useful to an animal under changing conditions of life, then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, can be hardly considered real. How a nerve comes to be sensitive to light, hardly concerns us more than how life itself first originated; but I may remark that several facts make me suspect that any sensitive nerve may be rendered sensitive to light, and likewise to those coarser vibrations of the air which produce sound. . . ."[2]

"If it could be demonstrated that any complex organ existed which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. But I can find out no such case. No doubt many organs exist of which we do not know the transitional grades, more especially if we look to much-isolated species, round which, according to my theory, there has been much extinction. . . ."[3]

"In the cases in which we know of no intermediate or transitional states, we should be very cautious in concluding that none

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[1] Being the principal part of an address delivered before the Biological Section of the Academy of Natural Sciences of Philadelphia, December 15, 1884.

[2] Darwin, Chas., "On the Origin of Species, by Means of Natural Selection, etc." New York (Appleton), 1861, p. 167.

[3] Darwin, Chas., Orig. of Species, etc., p. 169.

could have existed, for the homologies of many organs, and their intermediate states, show that wonderful metamorphoses in function are at least possible."[1]

It will be my endeavor to show the stages of development of the eye from the simple deposit of pigment in an epithelial cell to the highest form known to us, that of the vertebrata.

Invagination seems to be the most simple, as well as one of the commonest, methods by which organs are formed in the animal series. The formation of the gastrula, of the medullary canal, the development of glands, etc., etc., by invagination, are cases too well-known to require further comment. The formation of the eye, ear, and nose, form no exception to this rule.

In a previous paper[2] I have endeavored to show that the simplest expression of an organ of sight is found in the Lamellibranchiata. These simple organs, however, are not morphologically the primitive visual organs of the group, but *adaptive organs*, the ancestral eyes being present, in a few forms, only for a short time during the free larval stage of the animal; it is lost when the animal becomes fixed and the head excluded from the light.

We will hastily review these simple eyes. One of the simplest cases is found in *Ostrea virginica* (fig. 1), in which we have, on the free edge of the mantle, a number of epithelial cells containing a nucleus (*n*), a deposit of pigment (*p*) in their exterior extremities, and on the outer surface a fine transparent, refractive cuticula (*c*). There seems to be no protection for the organ, save the power of withdrawal of the whole mantle within the valves of the shell. Experiment conclusively proves that sight exists in these animals, as shown by Ryder.[3]

FIG. 1.—Visual cells of *Ostrea virginica*. *c*, cuticle; *p*, pigment; *n*, nucleus.

We next find these pigmented visual organs confined to a certain point of the mantle which has become specialized into the so-called siphon. In *Venus mercenaria* we have these cells, unprotected on the external surface of the siphon, but at the same time some cells are more or less protected at the base of the tentacles; but as this animal is able to retract the entire

[1] Darwin, Chas., Orig. of Species, p. 182.

[2] Sharp, B., On the Visual Organs in Lamellibranchiata. Mittheil. a. d. Zool. Stat. zu Neapel, Bd. v, 1884, p. 447.

[3] Ryder, J. A., Primitive Visual Organs. Science, vol. ii, No. 44, 1883, p. 789.

siphon within the shell, protection is thus afforded to these delicate organs.

When we find forms which are unable to wholly retract the siphon within the shell, the visual cells are confined to grooves at the bases of the tentacles. In the rapid withdrawal of the siphon through the sand, in cases of danger, we can easily see that the sharp particles would irritate any delicate organ, and protection must be afforded to them. Now, the possession of sight at the only exposed portion of the animal, would be of the highest value, in the struggle of life, to its possessor, if, when a shadow, like that of a rapacious fish, is thrown upon the organ of sight, a rapid retraction will save it from being nipped off.

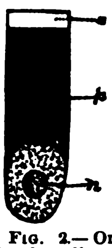

FIG. 2.—One visual cell of *Solen vagina*. *c*, cuticle; *p*, pigment; *n*, nucleus.

In *Solen vagina* and *S. ensis*, the former being the species on which I first satisfactorily proved the existence of a visual sense,[1] we find the cells have become much more developed, as is seen in fig. 2 (this being drawn to the same scale as that of fig. 1), but are essentially on the same plan as those in *Ostrea*. These cells line deep grooves at the bases of the tentacles and are found nowhere else, thus being amply protected from any injury. The nerves supplying these visual cells are probably the nerves of general sensibility, perhaps somewhat specialized.

The remarkable organs of *Pecten* and *Spondylus*, I will not here consider, as they throw no light on our immediate subject, and have been considered by me elsewhere.[2]

In passing next to a higher group, the Gastropoda, from which the Lamellibranchiata have probably degenerated, marked steps in advancement are to be noted.

In *Patella* we find that the pigment spots, or visual organs, take their morphological position, namely in the oral end of the body, and consist of a single pair in the base of the broad tentacle. More than a single pair of eyes are not found in the Gastropoda.[3]

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[1] Sharp, B., On Visual Organs in *Solen*. Proc. Acad. Nat. Sci. Phila., Nov. 6, 1883, p. 248; also, On the Visual Organs in Lamellibranchiata.

[2] Sharp, B., On the Visual Organs in Lamellibranchiata.

[3] The adaptive dorsal eyes of *Onchidium* form an exception, but the normal pair of cephalic eyes are present. See Semper, Carl, Ueber Sehorgane von Typus der Wirbelthiereaugen am Rücken von Schnecken. Wiesbaden (Kreidel), 1877.

In *Patella*, as shown by Fraisse,[1] there is a simple sphere, made up of pigmented cells, similarly formed as those described for the Lamellibranchiata. This sphere is open in front and allows the entrance of the external media.

Haliotis[2] gives us an advance; here we have an open sphere as in *Patella*, but instead of the refractive cuticula to each cell, they are physiologically combined into one mass, forming a lens. This lens is the product of the cells of the eye, and is purely a secretion—a simple cuticular lens, as is found in all the eyes of the invertebrata—while the lens of the vertebrata, where it exists, is always cellular. The cellular lens-like bodies found in the so-called eyes of *Pecten* and *Spondylus*, and the dorsal eyes of *Onchidium*, are exceptional, and will be treated of elsewhere.

Fissurella[1] gives us an eye that goes practically as far as any gastropod eye, the higher forms merely carry out, a little more in detail, this plan. This results in a closed eye containing a lens, the transparent epidermal covering acting as a cornea. The pigmented layer is as in *Haliotis*, namely, the cells composing it are devoid of a transparent cuticula, the lens and cornea serving as the refractive bodies.

The phylogenetic development of the molluscan eye, therefore (cephalopoda excepted), is as follows: (1), a pigmental surface of epithelial cells; (2), pigmented invaginated grooves for protection, at centralized points of the body, each visual cell having a cuticular body; (3), this groove contracting to an open sphere which closes; (4), the refractive bodies of each cell being centralized into a cuticular lens. A distinct nerve, specialized for sight, is developed (*Haliotis* and *Fissurella*), which connects the eye with the superior cephalic ganglia.

Now, let us see how the ontogenetic development agrees with the phylogenetic.

Bobretzky[3] and Haddon[4] have given us the development of

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[1] Fraisse, Paul, Ueber Mollusken Augen mit embryonalem Typus. Zeitschr. f. wis. Zool., Bd. xxxv, 1881.

[2] Fraisse, Paul, Ueber Mollusken Augen mit embryonalem Typus. Zeitschr. f. wiss. Zool., Bd. xxxv, 1881.

[3] Bobretzky, N., Studien über die embryonale Entwickelung der Gastropoden, Arch. f. mikr. Anat. Bd., xiii, 1877.

[4] Haddon, A. C., Note on the Development of Mollusca, Quart. Jour. Mic. Sci., n. s., vol. xxii, 1882.

the gastropod eye, the former in *Fusus*, and the latter in *Murex*. I have carefully investigated the embryological growth of this same organ in *Nassa*, and lastly, Carrière[1] gives an account of the regeneration of the eye after amputation in the Pulmonata.

We find that ontogeny merely recapitulates phylogeny, as we would naturally anticipate. There is first an invagination, which closing forms a sphere; in the cells of this invagination there is a deposit of pigment, and from them a cuticular lens is formed, which increases in size by the addition of concentric layers. A nerve is there developed and connects this eye with the superior cephalic ganglia.

We will now pass to consideration of the eyes of the vertebrata, which, with a few exceptions, are remarkable for the similarity in general plan of organization throughout the whole group.

I will not enter here into a detailed account of the work that has been done on this subject, nor into a description of the finer anatomy, except where necessary to illustrate points under consideration. I leave these to a future and more exhaustive work upon the "Anatomical and Physiological Evolution of the Organ of Vision," upon which my friend, Dr. Charles A. Oliver, and myself are now engaged, and which is to appear under our joint names.

The general structure of the eye of the vertebrata is well known, and I will here simply draw attention to some of the cardinal points.

The eye consists of a more or less spherical body, bounded in front by a transparent plate, the *cornea*, which is a continuation of the white opaque enveloping sheath of the eye-ball, called the *sclerotica*. Internal to this *sclerotica* is a layer of pigment (*choroïdea*), passing forward to about the position of the junction of the *cornea* and *sclerotica*, and also extending over the posterior wall of the iris. Lying on this pigmented layer is the *retina*, the sensory portion of which is considered to be a continuation of the optic nerve, and which passes beyond the equator of the eye to a point called the *ora serrata*. The cavity of the eye-ball is divided anterio-posteriorly into two principal chambers, the anterior one is again subdivided into two, called the anterior and the posterior chamber, and includes all the space anterior to

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[1] Carrière, Jus., Studien über die Regenerationserscheinungen bei den Wirbellosen. I. Die Regeneration bei den Pulmonaten. Würzburg, 1880.

the lens. The anterior chamber is divided from the posterior by the iris, the latter being a flattened projection of the vascular layer of the *choroïdea.* The hole in its centre is called the pupil. These two chambers are filled with a fluid called the *humor aqueus.* Back of the lens and *iris* is the largest chamber of the eye-ball, called the vitreous chamber, and contains a semi-fluid mass, known as the *corpus vitreum.*

The lens is a *cellular* body, suspended from the *process ciliaris* by the suspensory ligament; the *process ciliaris* of the *iris*, is an extension of the vascular layer.

The *retina* is composed of many layers; one of the most external, that which is directed toward the *choroïdea*, is called the layer of the rods and cones. The innermost layer, that next to the *corpus vitreum*, is the layer of fibres of the optic nerve; between these two are several ganglionic layers. The whole retina is practically transparent, and the light passes through it unchanged to the point of contact of the rods and cones with the pigmented layer. Here the light-motion is transferred into a "nerve-energy," which is transmitted to the perceptive centres of the brain,[1] no light-motion, of course, passes beyond the receiving sensory fibres internally. The optic nerve pierces the retina a little on the nasal side of the optic axis. It will thus be seen that the extraneous color-waves have, in their impinging upon the sensory tips of the rods and cones, passed through the entire thickness of the retina, before it has been put in a position to give a proper sensory impression. In fig. 3, I have given a diagrammatical representation. *R* is a ray of light passing through the retina, and impinging on the point of a rod or cone, *n* representing the return through the cells of the retina (*r*) to the nerve-fibres, and then passing by them to the brain, *B.*

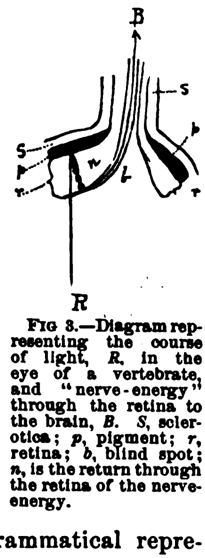

FIG 3.—Diagram representing the course of light, *R*, in the eye of a vertebrate, and "nerve-energy" through the retina to the brain, *B*. *S*, sclerotica; *p*, pigment; *r*, retina; *b*, blind spot; *n*, is the return through the retina of the nerve-energy.

Now, to consider the development of the eye, we find that in

[1] For a detailed account of this, see the forthcoming paper of Oliver, Charles A., "A Correlation Theory of Color Perception," Amer. Jour. Med. Sci., Jan., 1885. Dr. Oliver has kindly allowed me access to the manuscript of this article.

an early stage of the embryology of a vertebrate, the anterior end of the medullary groove, or canal, as the case may be, is divided into three segments, which later form the brain. The anterior of these is known by the name of fore-brain, or *proencephalon*; the middle one, or mid-brain, is called *mesencephalon*; and the posterior, the hind-brain, or *metencephalon*.

From the fore-brain proceeds outwards and laterally a swelling, which increases in size, and passes on to the epidermis. Here an invagination takes place, inward, to meet this outward brain-growth. This invagination finally closes, and soon becomes cut off, to form a hollow vesicle, the cavity of which is finally obliterated, and, becoming transparent, forms the lens of the adult eye. In the meantime, the growth from the brain has arched over and above this vesicle, and then folds over laterally to enclose the lens. This process of the brain is hollow, and communicates with the ventricular cavities of the brain.[1] This differentiation which has taken place, to form the so-called "secondary optic vesicle," is hardly an invagination in the true sense of the word, but is rather a double-walled plate, which folds downwards around the lens, this is indicated in the diagrammatic representation in fig. 4. The lens fills up the anterior opening of the cavity of the secondary optic vesicle, and as the two edges, *a* and *b*, close around the under surface of the lens, a certain amount of mesodermic tissue is included, which later forms the transparent *corpus vitreum*. After the closure is completed, there is a double-walled vesicle, the interior wall is the thicker of the two, and later gives rise to the many-layered *retina;* the external wall forms the pigment layer of the *choroïdea*. It not unfrequently happens that we find incomplete closure of the secondary optic vesicle, and when this is the case in the adult eye, the pathological condition known to physicians as *coloboma* exists. This may take place in the *iris* (*coloboma iridis*), or in the *retina*

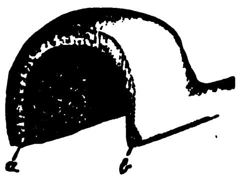

FIG. 4.—Diagram to illustrate the method by which the secondary optic vesicle encloses the lens which should fill up the open end. Eye of vertebrate.

[1] It must be borne in mind that the interior of the lens was once a part of the general surface of the body, and also the interior of the secondary optic vesicle, proceeding first by the formation of the medullary groove, and then from that inward.

(*coloboma retinæ*); in the latter case, on examining the eye with an ophthalmoscope, we can see a wedge-shaped white patch, the base downwards, at the inferior part of the background of the eye, the white is the sclerotica shining through. This is merely a reversion to a primitive state—a failure in the union, posteriorly, of the two lateral walls of the secondary optic vesicle.

The optic nerve is formed by the bending over, and union below, of the connecting portion of the secondary optic vesicle with the fore-brain. The portion of mesoderm included by this process is later termed the *arteria centralis retinæ*. The *sclerotica* and the vascular layer of the *choroïdea* are formed from the mesoderm, and are merely organs for the nourishment and the protection of the nerve-elements within.

It seems to me that the steps taken in ontogenic development of the eye, point out to us that the course which has been pursued in its phylogenesis from a simple epithelial pigmentary deposit, is as follows: The first visual organ primarily consisted of a deposit of pigment, centralized at that portion of the animal where it will be of the most use, viz.: at the oral pole. Since animals as a rule proceed with this extremity forward, they are developed in this situation; but in some cases, as in the Lamellibranchiata, as pointed out above, they are developed at that portion of the body which needs their protection. The next step in advance is to protect these important organs, and as a consequence invaginated grooves result, which gradually shorten to form a sphere. The refracting media of separate cells soon coalesce, to produce a cuticular lens. The nerves of general sensibility, connecting this eye with the brain, soon become specialized, and form a distinct (primitive) optic nerve. As the eye increased in importance and usefulness to its possessor, a corresponding stimulation took place in the brain, where sight is without doubt seated. Increased activity in any organ causes a corresponding increase in blood-supply—or better, *nutriment-supply*—and an increase of development took place all along the tract, from the eye to the seat of vision in the brain. As this increased, that part of the brain nearest the eye enlarged, and proceeded by steps *toward* the eye, similar to the process now taking place in the development of the eyes of the *Vertebrata*, the primitive optic nerve still connecting the two. We then have a stage in which a part of the brain closes over the superior part of the

eye, being separated by a layer of fibres, which is the much-shortened and flattened primitive optic nerve. The pedicle connecting this advanced part of the brain, which may be looked upon as a ganglion, we will now call the "secondary optic nerve," the optic nerve of the eyes of the adult *Vertebrata*. A similar state of affairs as this is found to-day in the eyes of the *Cephalopoda dibranchiata*. This ganglion soon becomes the most important part of the eye, and receives the light-waves upon its exterior wall, the primitive eye becoming transparent, and later forming the lens. This "*ganglion opticum*," as it may be provisionally called, gradually proceeds downwards about the primitive eye, joining below. As development and importance advance, we find the hollowing out of the *ganglion opticum*, this structure later is filled with the *corpus vitreum*, which is included, as was shown in the development of the eyes of the *Vertebrata*. Thus, I hold, if this hypothesis be a true one, that (1) the lens of the eyes of the *Vertebrata* is homologous with a primitive invaginated eye, such as we find to-day in the gastropoda; that (2) the layer of optic fibres of the *retina* is homologous with the primitive optic nerve. As the *retina* below has become the sensory part of the eye, the rays of light must necessarily pass through it, to reach a point where nerve-energy is developed. The *nervus opticus* of the eyes of the *Vertebrata* is, therefore, according to this view, really a secondary optic nerve.

We find in the vertebrata, and much more frequently in the invertebrata, blind animals, the near relatives of which have well-developed organs of sight. This blindness is due to the peculiar environments of the animal, such as cave life, where light is excluded; parasitism, etc., etc.

The *Proteus* of the Adelsberg grotto is an animal that is practically devoid of pigment. The eye of this practically blind animal is remarkable, inasmuch, that no lens is developed in the adult state. Our literature is unfortunately deficient in the embryology of this interesting form, so it is at present a matter of impossibility to state whether there *ever* exist a lens in the early development of the eye. The primitive optic vesicle has the form of that of the embryos of those vertebrates which have well-developed eyes in the adult state; the retina is a thick, many-celled layer, lying on the *stratum pigmentum*, which contains

a very meagre deposit of pigment; the anterior edge of this double-walled cup, formed by the retina and pigmented layer, come together, owing to the absence of the lens. It is stated[1] that no *corpus vitreum* is present. This degenerate eye is of little use to the animal, and, besides the loss of the lens, it is covered by the general integument of the body. Now it may be argued, upon my hypothesis, that the lens should be last to disappear, being phylogenetically the *first* to appear; but as the secondary optic vesicle has taken up the principal function of the eye, viz.: the developing of nerve-energy, we would naturally expect that the *accessory* organs would be the first to disappear in the process of degeneration; hence, the lens modified to an organ of refraction, although the most primitive part of the eye, would disappear before the secondary optic vesicle, since it has lost its function as an eye and acts merely as a refractive agent.

Another objection may be raised, which may be well to insert here, viz.: Why should the process from the proencephalon start before the invagination, to form the lens, the former being a secondary state in the phylogeny of the animal? I would explain this by the fact that as the optic vesicle, being now the most important part of the eye, and so established for many generations, now appears *first* and disappears *last* in degeneration.

In *Myxena glutinosa*, as described by Wm. Müller,[2] we have an eye consisting of the secondary optic vesicle, as in the case of *Proteus*, but open in front and filled with a plug of mesodermal tissue. The eye is entirely devoid of pigment and lies buried beneath a layer of muscle underlying the skin. The optic nerve passes into the vesicle, and terminates *in* the retina, there being no layer of optic nerve-fibres present at all. This eye has proceeded a step further in its degeneration, than the eye of *Proteus*, being *entirely* devoid of pigment, and having become more deeply imbedded, is covered by a layer of mesodermal tissue, the muscular stratum.

Thus in degeneration, the eye proceeds, step by step, backwards towards the brain, after first losing its accessories, such as the lens, *cornea*, *sclerotica*, etc.

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[1] Semper, Carl. Animal life as affected by the natural conditions of existence. Intern. Sci. Series, vol. xxx, New York (Appleton), 1881, p. 78.

[2] Müller, Wm. Ueber die Stammesentwickelung des Sehorganes der Wirbelthiere. Festgabe an Carl Ludwig. Leipzig (Vogel), 1875, p. vii.

In *Branchiostoma lanceolatum* we find the degeneration has reached its greatest extreme. There exists no trace of the eye, in form, and we recognize its existence only by a slight deposit of pigment on the anterior end of the neural canal. The brain itself has disappeared in this degenerate form, it going hand in hand with the eye, so that the only remnant of it is a spot of pigment on the anterior end of the neural canal.

Now this deposit of pigment that we find in *Branchiostoma*—and a similar deposit in the nerve-centres of some of the larvæ of the Ascidia, looked upon at one time as the ancestors of the Vertebrata, while they are if Vertebrata at all, greatly degenerated ones—led Lankester[1] to regard the primitive type of the Vertebrata as a transparent animal with eyes sessile on the brain. I am of the opinion that forms so degenerate as *Branchiostoma* and the *Ascidia* should not be taken as a standard, on which to base our conclusions for the origin of the Vertebrata.

In conclusion I may quote a passage from Tyndall,[2] which we have taken for our motto: " The eye has grown for ages *toward* perfection, but ages of perfect*ing* may still be before it."

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[1] Lankester, E. R., Degeneration, a Chapter in Darwinism. Nature series. London, 1880.

[2] Tyndall, John, Six Lectures on Light. London, 1878.

A REVIEW OF THE AMERICAN SPECIES OF STROMATEIDÆ.

BY MORTON W. FORDICE.

In the present paper I have attempted to collect the synonymy of the American species of *Stromateidæ*, and to give an analytical key for the identification of the species.

The specimens studied belong to the Museum of Indiana University.

Analysis of American Genera of Stromateidæ.

a. Ventrals very rudimentary or absent; preopercle entire; anterior rays of dorsal and anal fins more or less produced; scales very small and thin; caudal peduncle slender, not keeled; gill-membranes free from isthmus; caudal fin forked. *Stromateus.* I.

aa. Ventrals present, I, 5; edge of preopercle serrate; anterior rays of dorsal and anal fins not produced; scales rather small, firm; gill-membranes free from isthmus; caudal peduncle rather stout, not keeled; caudal fin lunate. *Leirus.* II.

I. STROMATEUS.

Stromateus Linnæus, Syst. Nat., x, 248, 1758 (*fiatola; paru*).
Rhombus Lacépède, Hist. Nat. Poiss., ii, 321, 1800 (*alepidotus*).
Chrysostromus Lacépède, Hist. Nat. Poiss., iv, 97, 1800 (*fiatoloides* = *fiatola*).
Fiatola Risso, Eur. Merid., iii, 289, 1826 (*fasciata*).
Peprilus Cuvier, Regne Animal, 1828 (*crenulatus*).
Seserinus Cuvier & Valenciennes, Hist. Nat. Poiss., ix, 416, pl. 276, 1833 (*microchirus*).
Poronotus Gill, Cat. Fish. East Coast N. A., 1861, 35 (*triacanthus*).

Analysis of American Species of Stromateus.

a. Pelvis ending in a small spine; ventral fins entirely wanting.

b. Dorsal and anal fins falcate; the length of their highest rays greater than that of head; back elevated; body suborbicular; snout vertical; height of body 1½ in length; D. III, 45; A. II, 43; vertebræ, 13+17; occipital crest very high, its vertical height from supra-occipital bone contained 3 in head (*Rhombus* Lac.). *paru.* 1.

bb. Dorsal and anal fins little falcate; the length of their highest rays less than head.

c. Region below dorsal fin with a series of pores; outline elliptical; height of body $2\frac{1}{3}$ in length; D. III, 45; A. III, 37; vertebræ, 14+19; occipital crest moderate, the height from supra-occipital bone 4 in head (*Poronotus* Gill). *triacanthus.* 2.

cc. Region below dorsal fin without conspicuous pores.

d. Form elliptical; height of body $2\frac{1}{4}$ in length; D. III, 45; A. II, 39; vertebræ, 14+17; occipital crest low, its height from supra-occipital bone $4\frac{2}{3}$ in head. *simillimus.* 3.

dd. Form broad-ovate; height of body, $1\frac{9}{10}$ in length; dorsal with 42 developed rays; anal with 32. *medius.* 4.

aa. Pelvis not ending in a spine (*Stromateus*); no trace of ventral fins.

e. Upper part of body with numerous round black spots; head, $4\frac{1}{3}$; depth, $2\frac{1}{4}$; D. VII, 40–43; A. III, 38. *maculatus.* 5.

1. **Stromateus paru**

Paru Brasiliensi congener Sloan, Jamaica, 2, 285, tab. 250, f. 4, 1727 (Jamaica).

Stromateus paru Linnæus, Syst. Nat., ed. x, 248, 1758 (based on Sloan's description); *ibid.*, ed. xii, 487, 1766; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 597 (Charleston, S. C.); Jordan & Gilbert, Syn. Fish. N. A., 914, 1882.

Chætodon alepidotus Linnæus, Syst. Nat., ed. xii, 460, 1766 (Charleston); Gmelin, Syst. Nat., 1240, 1788 (copied).

Rhombus alepidotus Lacépède, Hist. Nat. Poiss., ii, 321, 1800 (copied).

Peprilus alepidotus Goode, Proc. U. S. Nat. Mus., 1879, 112 (Fernandina); Goode & Bean, Proc. U. S. Nat. Mus., 1879, 130 (Pensacola); Bean, Proc. U. S. Nat. Mus., 1880, 92 (Beaufort, N. C.; Norfolk).

Stromateus alepidotus Lütken, Spolia Atlantica, 1880, 521; Jordan & Gilbert, Syn. Fish. N. A., 1882, 451; Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 156 (Jamaica); Jordan & Gilbert, Proc. Acad. Nat. Sci. Phila., 1884 (Egmont Key).

Sternoptyx gardenii Bloch & Schneider, Syst. Ichth., 494, 1801 (Carolina).

Stromateus gardenii Günther, Cat. Fish. Brit. Mus., ii, 399, 1860 (New Orleans; Jamaica; Bahia).

Stromateus longipinnis Mitchill, Trans. Lit. Phil. Soc. New York, i, 366, 1814 (New York Bay).

Rhombus longipinnis Cuvier & Valenciennes, Hist. Nat. Poiss., ix, 401, pl. 274, 1833 (New York); Dekay, New York Fauna, Fish, 136, pl. 75, f. 239, 1842.

2. **Latris peruanus.**

Cratarolophus peruanus Steindachner, Ichthyologische Beiträge, i, 10, 1874 (Callao).

Habitat.—Coast of Peru.

This species is known to me only from Steindachner's description.

On examination of the skeletons of the three species, *S. paru*, *triacanthus*, and *simillimus*, I find the first interhæmal greatly developed in each of the species. The occipital crest is very high in *S. paru*; it is medium in *S. triacanthus*, and low in *S. simillimus*. The hæmal and neural spines are more developed in *S. paru* than in the other species, thus corresponding to the form of the body. The vertebræ in *S. triacanthus* are somewhat more numerous than in the others, as stated in the analytical key.

3. Stromateus simillimus.

Poronotus simillimus Ayres, Proc. Cal. Acad. Nat. Sci., 1860, 84 (San Francisco); Cooper, Nat. Wealth Cal., 1868, 489.

Stromateus simillimus Rosa Smith, Fish. San Diego, 1880 (San Diego); Jordan and Jouy, Proc. U. S. Nat. Mus., 1881, 12 (San Diego; Santa Barbara); Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 46 ("Entire Pacific Coast, common, but most abundant from Santa Barbara to San Francisco"); Bean, Proc. U. S. Nat. Mus., 1881, 265 (name only); Jordan and Gilbert, Syn. Fish. N. A., 1882, 451.

Habitat.—Puget Sound to San Diego.

This species is common along the Pacific Coast, where it replaces *S. triacanthus* of the Atlantic Coast.

4. Stromateus medius.

Stromateus medius Peters, Berliner Monatsbericht, 1869, 707 (Mazatlan); Lütken, Spolia Atlantica, 1880, 521; Jordan, Proc. Phila. Acad. Nat. Sci., 1883, 284 (original type).

This species is now only known from the original type in the Museum at Berlin, erroneously described by Dr. Peters. In 1882 numerous specimens were collected at Panama by Prof. C. H. Gilbert, but all of these have been since destroyed by fire.

5. Stromateus maculatus.

Stromateus maculatus Cuvier and Valenciennes, Hist. Nat. Poiss., ix, 399, 1833 (Valparaiso); Jenyns, "Zool. Beagle, Fishes," 74, 1839; Gay, "Hist. Chile, Zool.," ii, 248, Atl. Ictiol. lam., 8 bis, f. 1; Günther, Cat. Fish. Brit. Mus., ii, 398, 1860.

Habitat.—Coast of Chili.

Head[1] $4\frac{1}{3}$ in length of body; depth $2\frac{1}{4}$; D. VII, 43; A. III, 39. Scales in lateral line about 160. Body ovate, compressed,

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[1] The description of *Stromateus maculatus* was added by Seth E. Meek, who alone is responsible for it.

dorsal and ventral outlines very similar to each other. Profile evenly convex (with curve a little shorter at occiput) to snout in front of nostrils, where it descends almost vertically. A slight depression on each side of head, above nostrils, which makes the profile more trenchant at that place.

Mouth not very small; the tip of maxillary does not quite reach vertical from front of eye; its length about 4¼ in head. The teeth of the lower jaw pass just behind those of the upper jaw, when the mouth is closed. Eye small, 5½ in head. Pseudobranchiæ well developed. Gill-rakers weak and flexible, 12 below the angle, the longest about ⅔ eye. Preopercle entire. Branchiostegals 6. Pelvis not ending in a spine. No trace of ventral fins. No pores along the base of dorsal fin. The soft dorsal and anal fins similar to each other, except that the anterior rays of dorsal are correspondingly higher than those of the anal.

The dorsal spines are distant from each other, and quite imbedded in the skin. The first spine is on the vertical above, from upper part of gill-opening. Distance of first ray of soft dorsal to tip of snout equals the depth of the body. Distance from first ray to last ray of soft dorsal is contained 1⅔ in length of body. Distance of first ray of anal to tip of snout about 2 in length of body. Base of anal 2 in length of body.

The mucus-pores on upper anterior part of head form a sort of irregular network. A main branch arises a little anterior to upper part of gill-opening, which sends off branches, extending backwards almost straight, and parallel to each other.

The greatest width of head 2 in its length; the greatest width of body (midway on a line from upper part of gill-opening to base of last anal ray) 2½ in head. Cheeks and opercles scaly.

Color in alcohol blue above, with numerous round dark blue spots, about ½ as large as eye; below silvery. Below pectorals, on anterior half of body, are some irregular blue markings. Pectorals blue; caudal yellowish, with faint bluish shade on tips of its rays. The pectoral fins are about as long as head.

The above description was taken from a specimen in very good condition, from Rio Grande do Sul, South America. The specimen is in the Museum of the Academy of Natural Sciences of Philadelphia. It was originally sent there from the Museum of Comparative Zoology. Length of specimen, 14 inches.

II. LEIRUS.

Leirus Lowe, "Proc. Zool. Soc., London," 1839, 82 (*bennetti* = *ovalis*).
Palinurus Dekay, New York Fauna, Fish, 118, 1842 (*perciformis*).
Crius Valenciennes, "Webb and Berthelot, Isles Canar. Poiss." (*bennetti*).
Pammelas Günther, Cat. Fish. Brit. Mus., ii, 485, 1860 (*perciformis*).
Palinurichthys Gill, Proc. Acad. Nat. Sci. Phila., 1860, 20 (*perciformis*).
Palinurichthys Bleeker, about 1860 (*perciformis*).

Analysis of American Species of Leirus.

a. Body ovate; the greatest depth, 2½ in length. Head, 3⅓; D. VIII, 20; A. III, 16; Lat. l. 75. *perciformis.* 1.

aa. Body more elongate, its greatest depth 3½ in length. Head, 3; D. VIII–IX, 26–28; A. III, 18; Lat. l. 80–90. *peruanus.* 2.

I follow Jordan and Gilbert in regarding *Leirus* as a genus distinct from *Centrolophus*, from which it differs chiefly in the differentiation of the dorsal spines, and in referring to *Leirus*, the *Palinurichthys perciformis* of American writers, which appears to be a near relative of *Leirus ovalis*, although Dr. Günther has placed it among the *Carangidæ*.

1. **Leirus perciformis.**

Rudder fish or *Perch coryphene* Mitchill, Lit. Phil. Soc., i, pl. vi, f. 7, 1814 (no description).

Coryphene perciformis Mitchill, Am. Month. Mag., ii, 244, 1818 (New York Harbor).

Palinurus perciformis Dekay, New York Fauna, Fish, 118, pl. xxiv, f. 25, 1842 (Shrewsbury Inlet).

Pammelas perciformis Günther, Cat. Fish. Brit. Mus., ii, 485, 1860 (Coast of New York).

Palinurichthys perciformis Gill, Proc. Phila. Acad. Nat. Sci., 1860, 20 (name only); Bean, Proc. U. S. Nat. Mus., 1880, 91 (Wood's Holl, Mass.; Off Noman's Land; New York Market; Newport, R. I.; Gloucester, Mass.; Fishing banks, off coast of Maine).

Lirus perciformis Jordan and Gilbert. Syn. Fish. N. A., 452, 1882.

Trachinotus argenteus Storer, Mass. Rep., 55, 1839 (Holme's Holl, Mass.; not of Cuvier and Valenciennes).

Habitat.—Maine to New York.

This species has apparently but a limited range on our Atlantic coast. It is apparently congeneric with *Centrolophus ovalis* Cuv. and Val., the type of Lowe's genus *Leirus*.

2. Leirus peruanus.

Centrolophus peruanus Steindachner, Ichthyologische Beiträge, i, 10, 1874 (Callao).

Habitat.—Coast of Peru.

This species is known to me only from Steindachner's description.

ON A REMARKABLE EXPOSURE OF COLUMNAR TRAP NEAR ORANGE, NEW JERSEY.

BY PROFESSOR ANGELO HEILPRIN.

The remarkable exposure of trap, near Orange, New Jersey, to which attention has recently been called by the State Geologist, Prof. George H. Cook, is in many respects the finest example of geotechnic architecture to be found in the Eastern United States. Although a true columnar structure is by no means a rarity in this State, indeed, rather the contrary, yet strikingly enough, where any extensive exposure of the trap occurs, there the columnar structure appears to be in most instances either only partially developed, or where developed, only of a very indeterminate character. This is well shown in the case of the Palisades fronting the Hudson River, where, for the greater part of their extent, only an approximation to anything like such structure can be made out. In the case of the locality presently to be described, however, which is situated on the face of the first interior ridge trending parallel with the Palisades, whose age probably differs but little, if at all, from that of the Palisades, we are presented with the reversed condition of things; the columnar structure is here developed, not only on a most imposing scale, but in all the varied conditions under which such structures appear.

The exposure of O'Rourke's quarry (Plate VIII) is located some one and a half or two miles back of Orange, on the slope of Orange Mountain, and, consequently, in the line of the first trap ridge. It measures 750 feet in length, and 98 feet 2 inches greatest height above the base or working line. The material quarried (worked now for a considerable number of years) is the familiar post-Triassic (?) "trap," or "greenstone," the material of the Palisades quarries, which, until recently, supplied the city of New York with a great part of the Belgian paving blocks. That which immediately arrests the attention of the visitor to the quarry is the magnificent display of the columnar structure, thousands of basaltic columns of the hexagonal and pentagonal pattern appearing, if not in the absolute perfection of the similar columns of the Giant's Causeway and Fingal's Cave, in a perfection but very little inferior to these. The base or lower half of the exposure is

made up of a vertical palisade of 120 or more columns, measuring individually from 15 to 40 or 42 feet in height, and from 3 to 5 feet, or even more, in thickness. Towards the middle the height of this palisade has been greatly reduced, partly through the failing of the columns themselves, and partly through the artificial destruction that has here been effected. Above this line, which in some parts is sheared off as evenly as though it had been manipulated by the hand of man, the columns suddenly diminish in size, and instead of retaining the vertical position, now arch diagonally upward and outward, meeting from opposite sides to form an apex immediately under the highest point of the exposure. Many of the columns rest horizontally, or nearly so. Beyond the horizontal layer, what may be considered as a third series of columns makes its appearance, and here, again, the vertical position is assumed. The material of the glacial drift, as indicated by a heterogeneous assemblage of pebbles and boulders, rests on top, forming the subsoil of the region.

The first impression produced upon the casual observer by the complete exhibit is one indicating disturbance; the arched or diagonally inclined, and apparently disturbed, position of the columns of the upper and inner portion of the mass, would seem to imply an upheaving thrust from below, just underneath the apex. In other words, it would appear that we were over the seat of some subterranean disturbing force, or in the centrum of volcanic action, and, therefore, in the position of a true vent. But had there been such a thrust as is here implied, we should expect to see its effects revealed in a fracture or dislocation below the top, whereas none such is apparent. On the contrary, the continuity of the columnar mass is fully as well marked on top as anywhere else, and no indications of special disturbance are anywhere manifest. We are hence forced to the conclusion that the irregular and apparently disturbed position of the columns is not in reality due to any disturbing agent, but is merely the result of peculiar conditions of cooling and solidification of the original molten substance (lava). In other words, while some portions of this molten lava "crystallized" into vertical prismatic columns, other portions "crystallized" horizontally, and in all the intermediate planes lying between the horizontal and vertical. This irregular method of columnar formation, a perfect parallel of

which is observed along the River Alignon in the Ardèche, was first critically discussed by the late Poulett Scrope, who investigated its causes midst the volcanic debris of Central France, and clearly determined that it was the result of irregular convection and radiation of heat, and consequent irregular solidification. The deep layers, where the loss of heat was effected slowly through conduction with the underlying rock, produced stout vertical columns; the more superficial layers, where radiation was most active, frequently produced horizontal columns, while between the two were found columns occupying all the intermediate positions.

NOTES ON SOME NEW FORAMINIFERA FROM THE NUMMULITIC FORMATION OF FLORIDA.

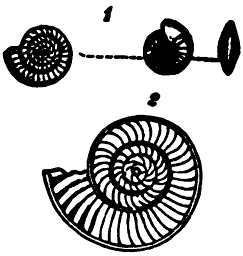
BY PROFESSOR ANGELO HEILPRIN.

Since the publication of my paper on *Nummulites Willcoxi* Heilprin (Proc. Acad. Nat. Sciences, July, 1882; reprinted in my "Contributions to the Tertiary Geology and Paleontology of the United States," Phila., 1884), in which the existence of a true Nummulite in the rocks of the North American continent was first indicated, I have had the good fortune to have passed under my supervision an extensive series of the Florida nummulitic rock. In these, for which I am indebted to the kindness of Mr. Joseph Willcox of this city, I have detected a considerable number of foraminiferal forms which have not hitherto been recognized, I believe, as occurring in the United States Tertiaries, but which are usually present in larger or smaller quantities wherever the nummulitic formation is largely developed. Among these, as coming from Hernando County, are the genera *Heterostegina*. *Sphæroidina*, *Biloculina* (?), *Triloculina*, *Quinqueloculina*, and *Spiroloculina*. The genus *Orbitoides* is very abundantly represented in two or more species, one of which, unmistakably the *O. ephippium* (*O. sella*), so distinctive of the Oligocene portion of the European *Terrain nummulitique*, appears pre-eminent for its large size. The great development of this species, irrespective of all other evidence, would almost be sufficient by itself to determine the age (Oligocene) of the rock formation in which it occurs.

Nummulites Floridensis.

Associated with these forms are very considerable numbers of the *Nummulites Willcoxi*, and also a second species of the same genus of very much larger size. In it the whorls expand very rapidly in size, and the septa, in addition to being comparatively more numerous, are considerably more flexed than in the commoner species. The test measures between one-third and one-half of an inch in diameter. I propose naming this species *Nummulites Floridensis*, although I am by no means satisfied that it may not prove to be identical with one of the many closely related forms that have

been described from the south of Europe, the West India Islands, and elsewhere. Only an actual comparison of specimens can, in most instances, determine specific identity or variation in the case of this most difficult group of organisms. Pending the interval which must of necessity intervene before such comparison can be made, I have deemed it the safer plan to describe and name the species, subject to revision.



Nummulites Willcoxi.
1. Natural size; 2. Enlarged.

A new locality for *Nummulites Willcoxi* has been found by Mr. Willcox, situated some fifteen miles to the northeast of the locality on the Cheeshowiska River, whence the species was originally obtained. Here the rock masses containing the fossils lie *in situ*, and at an elevation of not less than 150 feet above the sea. The existence of a true nummulitic basement formation in the State of Florida is thus placed beyond question, and, doubtless, the same will be found to have a very considerable extension inward.

No specimens of the *Operculina rotella* (= *Operculina complanata?*) have been detected in this newer series of rock fragments.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending November 30, 1884, thirty-two members and twenty-two correspondents have been elected.

Resignations of membership have been received and accepted, on the usual conditions, from J. Henry Simes and John Shallcross.

The deaths of eleven members and six correspondents have been announced. As these have been duly recorded in the Proceedings under the date of announcement, the names are not here repeated.

Thirty-three papers have been presented for publication, as follows: N. A. Randolph, 2; Miss S. G. Foulke, 2; David S. Jordan, 2; Angelo Heilprin, 2; Theo. Gill, 2; Seth E. Meek and Robert Newland, 2; Seth E. Meek and David K. Goss, 2; Seth E. Meek, 1; Seth E. Meek and Martin L. Hoffman, 1; Andrew J. Parker, 1; Benjamin Sharp, 1; Joseph Swaim and Seth E. Meek, 1; Rev. H. C. McCook, 1; Thomas Meehan, 1; Otto Meyer, 1; Rafael Arango, 1; Eugene N. S. Ringueberg, 1; Jos. Willcox, 1; Edw. Potts, 1; Henry J. Carter, 1; Frederick D. Chester, 1; D. G. Brinton, 1; Henry F. Osborn, 1; Herman Strecker, 1; Asa Gray, 1, and F. Lamson Scribner, 1.

These have all been printed in the Proceedings.

One hundred and twenty-eight pages of the Proceedings for 1883, and two hundred and sixty-four pages of the volume for 1884, have been printed and distributed, the latter being illustrated by six plates. Eighty-five pages of the Journal have also been published, completing the first part of the ninth volume. These pages contain the conclusion of A. J. Garrett's paper on Society Island Mollusca, illustrated by two lithographic plates, containing one hundred and fifty-two figures, and a valuable paper by Professor Heilprin, on the Tertiary Geology of the Eastern and Southern United States, illustrated by a colored map. The Publication Committee has recently been compelled by lack of means to decline a contribution to the Journal of a valuable paper, notwithstanding the fact that a series of beautiful illustrative plates were offered free of expense, except for printing.

Twenty-two foreign societies have been added to the exchange list, making now a total of 335 societies and journals, to which the numbers of the Proceedings are sent by mail as they are issued. Fifty-two of these receive also the Journal. Letters applying for deficiencies, and proposing exchange of publications as noted in the report of the Librarian, have been productive of the most gratifying returns.

The average attendance at the meetings during the year has been twenty-seven. Verbal communications have been made by twenty-six members; they have been for the most part published in the Proceedings.

The most important event in the history of the Academy during the past year, was the passage of an amendment to the charter by means of which the Society is empowered to hold a larger annual income than heretofore. The preliminary step to the securing of such an amendment was taken by the meeting held December 4, 1883, when the following preamble and resolutions were adopted by a unanimous vote:—

Whereas, The limit of the yearly income of the Academy of Natural Sciences of Philadelphia, fixed by the charter at eight thousand dollars, is, in the opinion of the members, insufficient for the necessary requirements of the corporation, therefore—

Resolved, That the officers of the Academy of Natural Sciences of Philadelphia be, and they are hereby authorized and empowered and requested to petition in due form the proper Court in Philadelphia, under the Act of Assembly of Pennsylvania, entitled "An Act to provide for the incorporation and regulation of certain corporations," approved the 29th day of April, A. D. 1874, to so amend the charter of said corporation as to enable the Academy to hold a much larger income, as follows, to wit: By striking out, in the proviso to Section I of said Charter, after the word "income," the following words—"of such estate shall not exceed eight thousand dollars, nor," and insert in lieu thereof the following words, "from the real estate shall not exceed twenty thousand dollars; nor shall the income of the corporation"—so that the proviso to said Section I, as amended, shall read as follows: "*Provided*, That the annual income from the real estate shall not exceed twenty thousand dollars; nor shall the income of the corporation be applied to any other purpose than those for which this corporation is formed."

After the required formalities had been complied with, the consent of the Court to the amendment applied for was announced to the Academy at the meeting held January 22, 1884, and at the following meeting, the thanks of the society were tendered, by resolution, to Mr. Uselma C. Smith, its solicitor, for his services in securing such action.

Chapter I, Article 6, and Chapter XVI, Article 4, of the By-Laws were amended by the meeting held October 28, as reported at length under that date on page 261 of the Proceedings.

On January 29, resolutions providing for an increase of the building fund of the Academy, were adopted, and on February 19 a committee, consisting of Dr. W. S. W. Ruschenberger, Dr. Chas. Schaffer, Mr. Geo. W. Tryon, Jr., Prof. Angelo Heilprin, and Dr. Horace F. Jayne, with power to increase the number, was appointed to carry the resolutions into effect.

Resolutions expressive of the Academy's interest in biological instruction, and urging the desirability of the endowment of biological professorships in connection with the Society, were adopted February 26.

At the meeting held March 18, a communication from Dr. William Pepper, proposing the establishment of a Biological Institute, to be under the joint control of the University of Pennsylvania and the Academy, was referred to the Council for consideration and report. While the subject was still under consideration, and before the Academy was called upon to take definite action upon it, a letter was received from Dr. Pepper acknowledging, on behalf of the Trustees of the University, the courtesy with which their former communication had been received, but expressing the belief that "it is, for the present at least, wiser for the University to pursue independently the development of the special field of biological work and teaching devolving upon her." Further consideration of the desirability of the proposed joint government was thereupon suspended, and the operations of the Academy's Committee on Instruction were carried on independently, as set forth in the reports of the several professors herewith presented.

Dr. Benjamin Sharp was elected Professor of Invertebrate Zoology January 29, and delivered his inaugural lecture on February 3.

Dr. D. G. Brinton was elected Professor of Ethnology and

Archæology February 26, and opened his course in a lecture delivered before the Academy April 4.

The resignation of Dr. J. Gibbons Hunt as Professor of Microscopic Technology was received and accepted May 27. His successor has not yet been appointed.

At the meeting of the Council held November 24, Mr. Jacob Binder was appointed Curator of the Wm. S. Vaux Collections, to serve, in compliance with the Articles of Agreement, during the ensuing twelve months. Mr. Binder accepted the position and declined receiving a compensation for his services. A resolution expressive of the Academy's appreciation of Mr. Binder's efficient discharge of the duties of his position during the past year, was adopted by the meeting held November 25.

During the meeting of the American Association for the Advancement of Science, held in September, the museum and library of the Academy were visited by many of the attending members, and by representatives of the British Association. The Academy is to be congratulated on having been able to add materially to the interest of the important occasion, both by the extent of its library and museum, and the receptions and excursions given under the auspices of its Botanical, and Biological and Microscopical Sections. The generous support given by the citizens of Philadelphia to the Local Committee, in its endeavor to provide fittingly for the meeting referred to, is an encouraging indication of an intelligent interest in science, and consequently in the welfare of the Academy and kindred institutions.

All of which is respectfully submitted,

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

The duties of the Corresponding Secretary, as defined by our laws, show very little variety from year to year. It is, however, gratifying to note that the number of societies with which we are in correspondence shows a notable increase. The transmission of our publications by mail, begun last year, places us in closer relation with foreign societies; many of them have agreed to reciprocate, while a few prefer the old method of transmission, for reasons which have been read at various times.

It being the duty of the Corresponding Secretary to acknowledge all gifts to the Museum, the usual circulars have been signed, and the Curator-in-charge, to whom the addresses are generally known, has sent them to the donors. A full account of the donations will appear in the Curator's report.

During the year ending November 30, there have been twenty-two correspondents elected, to all of whom notification has been promptly forwarded, and, excepting to those very recently elected, the diploma has also been sent. Of the correspondents elected during the present and past year, seventeen have acknowledged their election, many having at the same time transmitted valuable publications.

Official notification has been received of the death of Joachim Barrande, Quintino Sella and Sven Nilsson, correspondents.

While the number of letters from societies, etc., does not indicate the entire number receiving our publications, it may be interesting to note that nineteen are from societies, libraries, etc., in North America and Mexico, two from South America, and fifty-three from the Eastern Hemisphere. The entire number of letters, announcing the receipt of our publications, during the year is one hundred and nineteen.

Letters of transmission, with which foreign societies usually accompany their publications, have diminished during the year, owing probably to the transmission of the publications by mail. These letters number forty-four.

The activity of our Librarian, in endeavoring to supply deficiencies in our library, usually induces a corresponding demand on us from our corresponding societies. Letters of this character are noted to the number of nine.

Letters of a miscellaneous nature—in response to our invitation to exchange by mail, regarding deficiencies for which we have applied, announcing anniversary festivities—have been received from foreign societies, numbering nineteen.

In addition to the above, a considerable number of trivial letters have been received, and, where necessary, replied to, mostly entirely unimportant, and often of a purely personal nature.

Respectfully submitted,

GEO. H. HORN, M. D.,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

During the twelve months ending November 30, 1884, 3422 additions have been made to the library, an increase of 419 over the growth of 1883. These additions have consisted of 480 volumes, 2760 pamphlets and parts of periodicals, and 182 maps, sheets, photographs, etc.

They have been derived from the following sources:—

Societies,	1356
Editors,	866
I. V. Williamson Fund,	520
Authors,	280
Dr. G. E. Abbot,	145
Wilson Fund,	37
Department of the Interior,	29
Geological Survey of India,	19
Geological Survey of Sweden,	17
Russian Geological Commission,	16
Dr. F. V. Hayden,	15
Northern Transcontinental Survey,	14
Geological Survey of Belgium,	12
Geological Survey of Kentucky,	10
Minister of Public Works, France,	8
Department of Agriculture,	8
H. B. M. Government,	8
Treasury Department,	7
Prof. Angelo Heilprin,	6
Second Geological Survey of Pennsylvania,	6
Dr. R. J. Dunglison,	5
Geological Survey of Canada,	4
J. H. Redfield,	4
Engineer Department, U. S. A.	3
U. S. Fish Commission,	3
Navy Department,	2
Geological Survey of New Zealand,	2
War Department,	2
Trustees of British Museum,	2
Smithsonian Institution,	2
Ex. of Wm. S. Vaux,	1
Commissioners of Inland Fisheries,	1
F. G. Schaupp,	1
East Indian Government,	1
Geological Survey of Roumania,	1
Census Commission of Buenos Aires,	1
W. H. Dougherty,	1
Department of Mines, Nova Scotia,	1
Royal College of Surgeons,	1
Justin Winsor,	1
Trustees of Indian Museum,	1
Brazilian Museum,	1
Dr. A. E. Foote,	1
Chas. E. Smith,	1

The departments of the library, to which these additions were distributed, and the proportions of such distribution, are as follows:—

Journals,	2382
Geology,	250
Anthropology,	166
General Natural History,	103
Conchology,	82
Botany,	55
Anatomy and Physiology,	53
Entomology,	51
Medicine,	45
Chemistry,	40
Physical Science,	28
Ornithology,	21
Helminthology,	20
Education,	20
Voyages and Travels,	14
Mammalogy,	13
Agriculture,	12
Encyclopedias,	12
Bibliography,	12
Ichthyology,	11
Mineralogy,	10
Geography,	3
History,	1
Miscellaneous,	23

In consequence of the necessary curtailment of appropriations, no binding has been done during the year. It is to be hoped

that a permanent Binding Fund may be soon placed at the disposal of the Library Committee. While the estimate for binding is, properly enough, one of the first to be curtailed when expenses have to be reduced, yet our rapidly increasing sets of journals and the many valuable illustrated books which reach us in parts as issued, are in danger of being injured or rendered incomplete while used in the unbound form.

The card catalogue of periodicals has been completed, and will be transcribed in the form of a hand catalogue for the greater convenience of those consulting this, perhaps the most important, department of the library. Occasion was taken as the catalogue progressed to make careful memoranda of deficiencies. 243 letters have been written applying for lacking parts and volumes of incomplete sets of journals now in our possession, and 59 proposing exchange with societies, the publications of which are not represented on our shelves at all. The responses to these letters have been of such a satisfactory character as to account, perhaps entirely, for the excess of additions over the number reported at the last annual meeting.

In recording the completion of the important work noted, it gives me pleasure to acknowledge the efficient service of Mr. Emanuele Fronani, of whose assistance I have again been enabled to avail myself during the summer months.

The catalogue of the library, may be now said, for the first time in many years, to be complete. Care is, of course, taken to add the titles of accessions immediately on their presentation.

The portrait of the late Dr. Robert Bridges, which was approaching completion when my last report was presented, has been placed in its proper position in the gallery of Presidents, and is considered an unusually satisfactory likeness. The Academy is indebted for it to Messrs. Geo. W. Tryon, Jr., W. S. W. Ruschenberger, Thos. Meehan, Jos. P. Hazard, J. H. Redfield, Jacob Binder, C. S. Bement, Harrison Allen, John Ashhurst, Jr., Edw. S. Whelen, Chas. Schaeffer, Aubrey H. Smith, John S. Haines, Samuel Lewis, Geo. H. Horn, John Welsh, Chas. E. Smith, Jos. Wharton, Isaac Lea, and George Vaux.

In view of the amount of work accomplished and the results thereof, the past year, in this department of the Academy, may be regarded as an unusually prosperous one.

All of which is respectfully submitted,

EDW. J. NOLAN,
Librarian.

REPORT OF THE CURATORS.

The Curators present the following statement of the Curator-in-charge, Professor Angelo Heilprin, as their report for the year ending November 30:

Work in the various departments of the Museum, has during the past year, as in previous years, been largely of a volunteer nature, but, for this reason, none the less systematic, nor less valuable to the Academy.

The Conchological, Entomological and Botanical departments, under direct control of the Conchological, Entomological and Botanical Sections of the Academy, have benefited almost exclusively from services of this kind, and the same is true of the Mineralogical department covered by the Wm. S. Vaux trust. The Academy feels itself under deep obligation to the special conservators who have so generously contributed their time and labor to the interests of the institution.

In departments other than those here indicated work has not been neglected, but, unfortunately, because of the limited means at the disposal of the Curators, and for general want of space, which together constitute an almost insuperable obstacle to the proper care and exposition of the vast, and still rapidly increasing, collections of the institution, not so much has been accomplished as might have been desired.

The entire series of alcoholics has been carefully overhauled, and the necessary disposition of alcohol toward the preservation of these perishable objects made. The collection may be said to be in a fairly good condition. The recent mammalia have all been redetermined and relabeled, and arranged according to the most approved systems of classification. In this department, the Academy is seriously deficient, and it is to be hoped that at no very distant day the numerous gaps that everywhere occur may be filled in. A complete catalogue has been prepared, showing the Academy to possess just 400 species and varieties, represented in all by 904 specimens.

In the department of Ornithology comparatively little has been accomplished; the accessions have been very limited, as, indeed, they have been for a number of years past. Although the collection of birds still ranks as one of the most complete, and in some respects, the most complete of any in the world, following

immediately after the collections of the British Museum, the National Museum of Vienna, and the University of Leyden, it has of recent years attracted but few students or specialists to its cases, a deplorable condition, doubtless due in great part to imperfect arrangement (incident to the want of a special curator) and the circumstance of the 35,000 or more specimens being mounted, instead of in the far more serviceable form of skins. The absolute necessity of having a specialist, whose services should meet with fit pecuniary compensation, in this, as in all other departments, cannot be too strongly insisted upon. Long neglect of a department means, practically, its collapse, at least so far as the advantages to be derived from it by special students are concerned, and unless it can be adequately supported, must ultimately, by its occupancy of space and the use of time in its preservation, become a drag rather than a spur to the institution of which it forms a part. Despite the general richness of the ornithological collection, it has, through want of adequate means for its support, suffered to such an extent that at the present time it lacks no less than about 170 species or varieties of North American birds alone!

The Conchological department, on the other hand, which has for two decades enjoyed a constant supervision from the part of a distinguished conchologist, is singularly complete, and both in the number and variety of its forms, stands unsurpassed by any similar collection, whether in this country or Europe. It comprises no less than 150,000 specimens, mounted on upwards of 42,000 tablets, and it alone, of all the various departments, represents the actual state of a zoological science as we now know it.

During the year a selection of birds from the general collection has been laid aside to complete a special collection illustrative of North American ornithology.

The work of re-arranging and classifying the geological and paleontological specimens has made considerable progress.

The "local collection," intended for the illustration of the natural products of the States of Pennsylvania and New Jersey, is, as far as the resources of the general collection would permit, complete, except in the department of entomology, for which no suitable cases have as yet been provided. A cabinet of the minerals belonging to the same geographical area has recently been placed in the Museum for the benefit of students. It is

intended to further complete this department by a serial exposition of the rock masses about Philadelphia, and by the preparation of a relief map illustrative of the geology of the city and its immediate surroundings.

The work of labeling and mounting the Wm. S. Vaux collection of minerals, comprising upwards of 6412 specimens, has been completed; a report of progress in this department, prepared by the special Curator, Mr. Jacob Binder, is herewith appended.

One of the most striking accessions made to the Museum during the past year, is the collection of insect and aranead architecture, deposited by one of the Vice-Presidents of the Academy, Dr. H. C. McCook. It is, doubtless, the most complete of its kind in this country, and may be considered to be, in many respects, unique. A valuable collection of fishes from the southern and western waters of the U. S., made by Prof. D. S. Jordan and Mr. Seth E. Meek, has been added to the Ichthyological department.

Various alterations have been made during the current year in the ground floor of the Academy building, but these require no special consideration. Specimens from the Museum have been loaned for study to the Smithsonian Institution, to Prof. James Hall, of Albany, Prof. R. P. Whitfield, of New York, Prof. W. B. Scott, of Princeton, and Mr. Dobson, of London, who have severally rendered service to the Academy by the redetermination or description of the forms that passed through their hands.

The Academy has during the year benefited through the services of five Jessup Fund beneficiaries, who, apart from their studies, have in various ways coöperated with, or assisted, the Curator-in-charge, who hereby acknowledges his thanks. The Curator-in-charge also takes this opportunity of acknowledging his special indebtedness to Mr. Alan F. Gentry, who, during the greater part of the year, has most efficiently acted as his assistant.

Very respectfully,

ANGELO HEILPRIN,
Curator-in-charge A. N. S.

JOSEPH LEIDY,
Chairman Board of Curators.

SUMMARY OF THE REPORT OF WM. C. HENSZEY, TREASURER,

For the Year ending Nov. 30, 1884.

Cr.

Salaries, Janitors, etc	$3319 93	
Freight	42 70	
Repairs	271 71	
Insurance	55 00	
Coal	551 00	
Printing and Binding Proceedings	838 59	
Mounting Plants	4 40	
Printing and Stationery	114 42	
Vials	6 00	
Plates and Engravings	378 00	
Postage	158 94	
Water Rents	28 35	
Newspaper Reports	70 00	
Gas	111 92	
Books	276 79	
Miscellaneous	472 38	
A. Heilprin, Receipts Committee of Instruction	64 00	
H. C. Lewis, Receipts, Committee of Instruction	235 00	
Uselma C. Smith, Solicitor, Expenses securing Amendment to Charter Acad. Nat. Sciences	25 10	
G. D. Camden, Professional fee, Opinion in regard to lands in Tyler Co., W. Va	50 00	
Instruction and Lecture Fund, transferred to this Fund.	150 00	
Life Memberships transferred to Life Membership Fund	500 00	
		$7724 23

Dr.

To Balance from last account	$ 226 59	
" Initiation Fees	290 00	
" Contributions (semi-annual contributions)	1602 48	
" Life Memberships	500 00	
" Admissions to Museum	368 35	
" Sale of Guide to Museum	30 00	
" Publication Committee	617 92	
" Fees, Lectures on Palæontology	64 00	
" " " " Mineralogy	235 00	
" Miscellaneous	32 17	
" Interest from Mortgage investment, Joshua T. Jeanes' Legacy	1000 00	
" Wilson Fund. Towards Salary of Librarian	300 00	
" Publication Fund. Interest on Investments	355 00	
" Barton Fund. " " "	240 00	
" Life Membership Fund. " " "	165 00	
" Maintenance Fund. " " "	155 00	
" Eckfeldt Fund. " " "	125 00	
" Stott Legacy Fund. " " "	100 00	
" Interest on Money awaiting Investment	79 28	
		6485 79
Balance overdrawn, General Account		$1238 44

THOMAS B. WILSON LIBRARY FUND.

By Balance per last statement	$222 55
For Books	279 73
Transferred to General Account, toward Salary of Librarian	300 00
	$802 28
Income from Investments	525 00
Balance overdrawn	$277 28

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement	$ 500 00
Interest on Investments	165 00
Life Memberships transferred to this account	500 00
	$1165 00
Transferred to General Account	165 00
To Balance for Investment	$1000 00

BARTON FUND. (For Printing and Illustrating Publications.)

Interest on Investments	$ 240 00
Transferred to General Account	240 00

JESSUP FUND. (For Support of Students.)

Balance per last Statement	$ 595 01
Interest on Investments	560 00
	$1155 01
Disbursed	535 00
Balance	$620 01

MAINTENANCE FUND.

Balance per last Statement	$ 8 14
Interest on Investments	155 00
Thos. P. Cope. deceased. Legacy	1000 00
R. G. Curtin, M. D. Subscription	5 00
	$1168 14
Transferred to General Account	155 00
To Balance for Investment	$1013 14

PUBLICATION FUND.

Income from Investments	$ 355 00
Transferred to General Account	355 00

ECKFELDT FUND.

Income from Investments	$ 125 00
Transferred to General Account	125 00

I. V. WILLIAMSON LIBRARY FUND.

Balance per last Statement		$ 770 41
Rents Collected		1000 00
Ground-rents Collected		936 53
Cash received. Principal of yearly ground-rent for 52$\frac{50}{100}$ Dollars. E. S. Lingo St., 170 feet north of Dickinson St.	$875 00	
Four Months' Interest on same	17 50	892 55
		$3599 44
For Books	$1116 66	
Taxes and Water-rents	195 51	
Repairs to Properties	95 82	
Collecting	96 80	
		1504 79
Balance		$2094 60

$875.00 of the above Balance is to be re-invested.

INSTRUCTION AND LECTURE FUND.

Balance per last Statement	$ 56 00
Transferred from General Account	150 00
	$206 00
Disbursements	63 30
Balance	$142 70

MUSEUM FUND.

Interest on Investments	$ 50 00
Disbursements for Minerals, etc	45 00
Balance	$5 00

VAUX FUND.

Balance per last Statement		$428 84
Income from Investments		650 00
Sale of Cabinet		50 00
		$1128 84
Minerals	$272 71	
Cases	222 40	
Book	8 00	
Models	65 00	
Cards	2 75	
Furniture, etc., for Room	80 68	
		651 54
Balance		$477 30

MRS. STOTT FUND.

Income from Investment	$100 00
Transferred to General Account	100 00

BOOK ACCOUNT. (Jos. Jeanes' Donation).

Balance as per last Statement	$37 18

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTIONS.

The Curator of the William S. Vaux collections respectfully reports to the Council of the Academy of Natural Sciences:—

The arrangement and labeling of the minerals are now complete, each of the groups having labels indicating the chemical properties, the proportions in which the elements combine, the degree of hardness and specific gravity of each of the species. They are arranged in thirty-six horizontal and five upright cases. One of the upright cases has been made use of for the purpose of illustrating the six systems of crystallography—the forms of crystallization and the structure of crystals being demonstrated by typical specimens of minerals belonging to each system, and by six glass models, having the axial lines represented by threads of different color. In this case will also be found minerals representing the relative degrees of hardness.

The Archæological collection has been entirely rearranged. All implements, such as axes, celts, chisels, gouges, arrow-heads, pipes, pottery, etc., belonging to the same locality, being placed together. This method was suggested by Professor Putnam, of Cambridge, and Professor Brinton, of our own Academy, and is thought to have advantages for ethnological study. By this method the McBride collection (which is considered of undoubted authenticity), has been placed in the Ohio group.

The localities represented are Ohio, Indiana, Illinois, Michigan, Pennsylvania, New Jersey, New York, Massachusetts, Connecticut, Maine, Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Texas, Missouri, Wisconsin, California, and the Pacific Coast, together with Mexico, Costa Rica, Peru, Switzerland, Denmark and Sweden. There are also a few Roman, Carthagenian and Egyptian specimens. They number in all 2940 pieces.

An alphabetical catalogue of the mineral collection has been made, indicating the page and number in Dana, and the case containing the particular specimen.

In my report of November, 1883, the number of minerals was counted by trays, notwithstanding many of them contained more than one specimen. I am informed that this is not the practice

in other museums, either in this country or in Europe, nor does this method do justice to the collection. The same may be said with regard to the Archæological part.

The present method is based on the actual number of specimens, without regard to the number of trays, and is as follows:—

Mineral specimens,	6,391	
Crystallographic models,	6	
Models of historical diamonds,	15	
		6,412

representing about 500 species.

It may be of interest to members of the Academy to know the whole number of minerals contained in the Museum of the Academy (though not strictly in the line of this report); with the assistance of Mr. W. W. Jefferis, the specimens were counted as follows:—

Mineral specimens, Academy proper,	9,633
Lithological specimens, Academy proper,	1,301
Total,	10,934
W. S. Vaux collection,	6,412
Total,	17,346

It will be remembered that, according to terms of the agreement upon which this collection was accepted by the Academy, all specimens purchased from the fund provided for increase, were subject to the approval of the Curators of the Academy in conjunction with the Curator of the collection.

In making purchases, such specimens only have been bought—

1. As represent new species.
2. Species not represented in the collection.
3. Species representing new localities.
4. Such as are superior in character to those already in the collection.

Sixty specimens have been purchased during the year 1884, as follows:—

Minerals,	32
Indian relics,	7
Crystallographic models,	6
Historical diamond models,	15

The collection has been visited by a ge n of during the past year, many of them

especially during the recent meeting of the American and British Association for the Advancement of Science. I have been much gratified to hear expressions of admiration of the collection, many of the specimens being pronounced unique in their character, and not represented in the museums of Europe.

In conclusion, I embrace the opportunity of thanking those of my friends who have expressed a warm interest in my work, and have aided me with valuable suggestions. I take the liberty of making special mention of Dr. Leidy, Mr. W. W. Jefferis, Clarence S. Bement, and Dr. W. S. W. Ruschenberger.

Very respectfully submitted,

JACOB BINDER,

Curator.

REPORT OF THE MICROSCOPICAL AND BIOLOGICAL SECTION.

During the past year, eighteen stated meetings and one public exhibition were held.

The average attendance of members was about fifteen.

At the exhibition given in September to the visiting members of the American Association for the Advancement of Science, a very large audience was present, and the display of microscopes and objects excelled all previous ones, both in number and in scientific importance.

During the year, Dr. N. A. Randolph, Dr. Benjamin Sharp, and Joseph Mellor were elected members.

Edward S. Campbell, Hugo Bilgrim, and Sara Gwendolen Foulke were announced as contributors.

Dr. J. H. Simes and Prof. H. C. Lewis resigned membership.

Dr. Robert E. Rogers died.

Among the more important contributions by members during the year, were:—

A lecture, December 17, 1883, by Dr. M. B. Hartzell. Subject—The Bacteria.

February 4, 1884, by Dr. Benjamin Sharp. Subject—Section Cutting.

March 17, by Mr. W. N. Lockington. Subject—The Fishes of North America and the West Coast.

April 21, by Dr. Sharp. Subject—The Eye of the Invertebrates.

May 5, by Dr. J. G. Hunt. Subject—Fertilization in Some Plants.

May 9, by Dr. Hunt. Subject—The Bioplasm of the Cell.

June 2, by Dr. Geo. A. Rex. Subject—The Myxomycetes of Fairmount Park.

Respectfully submitted,

ROBT. J. HESS, M.D.,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that during the past year, the Academy has, as heretofore, continued to publish such papers upon the subject of the Mollusca as have been approved by its Publication Committee.

One member and seven correspondents have been elected. We have no deaths to report; neither has there been any change made in the By-Laws governing the Section.

From the eighteenth annual report of Mr. Geo. W. Tryon, Jr., Conservator, we find that during the year ending December 1, 1884, sixty donations of mollusks and shells have been received from thirty-one persons. The number of trays and labels thus added to the collection is 1126, of specimens 5224; larger accessions in both cases than for several previous years. The Conchological Museum now contains 42,448 trays and written tablets, with 151,015 specimens.

The most important accession of the year is a remarkably fine suite of shells, collected last winter by Mr. Henry Hemphill, on the West Coast of Florida. Most of the specimens are in much finer condition than those previously in our Museum, from the same region; many of them, hitherto known as West Indian, are now first ascertained to inhabit our coast, and not a few are new species. During the last summer, at the instance of Mr Wm. G. Binney, Mr. Hemphill explored the mountains of North Carolina for Helices, collecting a number of rare and fine specimens, of which, by Mr. Binney's generosity, we have obtained a share. This winter Mr. Hemphill is again spending on the Florida Coast, southward of his last year's operations, and arrangements have been made by which we shall receive a series of his collections.

A very complete suite of the shells of our national capital were presented by Mr. F. Lehnert.

Three donations of foreign shells are of unusual interest, namely: From E. Marie, a series of the shells of the island of Guadeloupe, W. I.; from Andrew Garrett, eighty-four species of land shells of the Society Islands, including all the types figured in his paper on this molluscan province, recently published by the Academy; from Dr. S. Archer and the Conchological Section, over three hundred species of marine shells, collected by Dr. Archer at Singapore. Another box, just received from Dr. Archer (contents not yet presented), will bring up our representation of the Singapore mollusks to upwards of five hundred species.

A detailed list of the additions to the Museum accompanies this report (see Curator's report).

The re-arrangement of the Conchological Museum steadily progresses. During the year, the Pleurotomidæ, Terebridæ and Cancellariidæ of the marine gastropods have been carefully studied, and, to a considerable extent, re-labeled and mounted. A commencement has also been made with the series of Pulmonata, by the re-arrangement of the Testacellidæ, Oleacinidæ and Streptaxidæ.

Our Museum cases have become so overcrowded that the display of all the species, under glass, is no longer possible; in many instances, the trays of specimens are piled up several tiers in height, so that the under rows cannot be seen. Unless better and more ample accommodation for the shell collection is soon provided, it may become necessary to withdraw portions of it from exhibition, in order to afford space for the display of the larger and more important specimens.

At the annual meeting of the Section, held on the 4th inst., the following officers were elected:—

Director, ...	W. S. W. Ruschenberger.
Vice-Director, . . .	John Ford.
Recorder, ...	S. Raymond Roberts.
Secretary, ...	John H. Redfield.
Treasurer, ...	Wm. L. Mactier.
Conservator, ...	George W. Tryon, Jr.
Librarian, ...	Edward J. Nolan.

Respectfully submitted, on behalf of the Section,

S. Raymond Roberts,

Recorder.

REPORT OF THE ENTOMOLOGICAL SECTION.

During the year 1884, the Entomological Section has held its regular monthly meetings, dispensing as usual with those of July and August. The attendance has been fair, but by no means so large as is desirable. It was found that several members had been prevented from attending the Section, owing to other engagements. To remedy this, and with a hope that the change would be beneficial, by accommodating more persons, the Section, at its meeting held December 8, voted to change the time of meeting from the second Friday night to the fourth Monday night of each month, commencing January, 1885. The failure to secure additions to the membership has been very discouraging to the members of the Section, and it is earnestly hoped that the members of the Academy will assist in increasing the number.

The collections under the supervision of the Section, are at present in quite good condition. Much work has been done in the way of disinfecting and arranging the specimens. In an entomological cabinet this requires constant watchfulness, and cannot be dispensed with. The thanks of the Section are due to Mr. S. F. Aaron for much of this work.

Additions to the collection during the past year have been quite small. This has been principally owing to the fact, that those members generally most active in collecting, have been compelled by other more pressing calls, to defer such work to the future.

In connection with the American Entomological Society, there have been published, during the year, articles upon Entomology, amounting to 335 pages of printed matter, together with 9 plates. In addition, there has been printed a biographical sketch of John L. Le Conte, M. D., late Director of the Section, written by S. H. Scudder, also posthumous papers of the same gentleman, edited by Dr. Geo. H. Horn, comprising in all 68 pages, making a total of 403 printed pages. These entomological contributions continue to maintain the high standard of the journal in which they appear.

At the meeting held December 8, the following were elected officers of the Section for the year 1885 :—

Director, ...	Geo. H. Horn, M. D.
Vice-Director, . . .	Rev. Henry C. McCook, D. D.
Recorder, ...	James H. Ridings.
Treasurer, ...	E. T. Cresson.
Conservator, . . .	Henry Skinner, M. D.

Respectfully submitted,

James H. Ridings,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section has to report to the Academy that the affairs of the Section are in a generally prosperous condition.

Our Herbarium, already one of which the Academy is justly proud, has been increased in new species 407 the past year, without including the additions among the lower cryptogams. The excellent progress made in other matters, under the superintendence of the Conservator, Mr. John H. Redfield, is set forth in detail in his annual report to the Section, which is submitted herewith as part of the Section's report.

Meetings have been held regularly every month, except July and August, the average attendance for the whole year being slightly larger than last.

The Section is free from debt, and has a considerable balance in its treasury.

One of the events of the year was the social re-union and entertainment, in the hall of the Academy, of the botanists in attendance on the meeting of the American Association for the Advancement of Science, under the auspices of the Section. The expense was borne by the members of the Section, without any draft on its regular funds, or on the funds of the Local Committee of the Association. It is believed that the result will be useful to the Academy, in making the work of the botanical department better known, reacting in the interest of botany everywhere.

At the meetings of the Section many matters of interest to botanists have been presented, and some, by Professor Gray, Professor Rothrock, and Messrs. Meehan and Scribner, deemed of sufficient general importance to appear in the Proceedings of the Academy.

The officers elected for the ensuing year are:—

Director,	Dr. W. S. W. Ruschenberger.
Vice-Director,	Thomas Meehan.
Recorder,	F. Lamson Scribner.
Cor. Secretary, *Treasurer*,	Isaac C. Martindale.
Conservator,	John H. Redfield.

Respectfully submitted,

THOMAS MEEHAN,

Vice-Director.

Conservator's Report for 1884.—The Conservator has, during the past year, continued to direct his attention to the care and improvement of the Academy's Herbarium, so far as was compatible with the demands on his time and labor occasioned by receiving, preparing and placing new accessions. With some assistance from Mr. Scribner, certain portions of the North American Herbarium have been mounted, mainly of genera more especially needing this care, such as *Viola*, *Polygala*, *Lupinus*, *Dalea*, *Astragalus*, *Oxytropis*, *Potentilla*, *Eriogonum*, and others. Mr. Burk is now engaged in the work of re-arranging the North American Compositæ after Gray's New Synoptical Flora. In the General Herbarium the provisional alphabetical lists of species have been carried forward as far as Loranthaceæ. These lists, imperfect and defective as they are, will justify the labor expended upon them, by the time saved to every one consulting the Herbarium. It is hoped that this merely preliminary work will soon be completed, and prepare the way for more deliberate and careful elaboration by expert botanists.

During the latter part of the summer our work had to be temporarily suspended by the necessary preparations for receiving the members of the American Association for the Advancement of Science at its September meeting in this city, and the gratification expressed by them on the visits to the Academy's library and herbarium, for the fraternal fellowship extended by our Section, is a source of satisfaction to us all.

The donations of plants during the past year amount to 3183 species, of which 407 are new to our collection. In these donations are included three Centuries of Ellis' North American Fungi, of which a large proportion are probably new to us, and

should be added to the above 407. The North American species received have been 1792, from tropical America were 3, and from the old world 1388. Among the additions may be specified 1057 species, mostly European and North African, from the fine Herbarium of Geo. Curling Joad, presented by Dr. Gray. Though the most of these duplicated species which we already possessed, yet being choice specimens, collected and ticketed by eminent botanists, they greatly add to the value of our working material, while about one-tenth of them were previously unrepresented on our shelves. Our fellow-member, Mr. Canby, who, it will be remembered, was in charge of the Botanical Department of the Northern Transcontinental Survey, during the years 1882 and 1883, in the interest of the Northern Pacific R. R., has contributed a very valuable suite of the collections made by himself, and by Scribner, Brandegee, Tweedy and others under his direction, along the northern border of Western North America, in the Territories of Dakota, Montana and Washington. This series comprehends 851 distinct species of which about 90 were new to us. Our Vice-Director, Mr. Meehan, has also given us the result of his herborizations along the coast of Washington and Alaska Territories, during the summer of 1883, in a collection of 207 species, which, however add only five species to our earlier Alaskan collections received from Kellogg, Harrington, Dall, and others. Other smaller but valuable donations, will be detailed in the Academy's Donation List for 1884.

In large collections, where constant accessions, during a long period of years, have repeatedly duplicated species, there is always a tendency to exaggerated estimates of the number of *species* represented. In regard to the Academy's Herbarium, the estimates have been so vague and so evidently excessive, that the Conservator has been led to undertake an actual enumeration. This apparently simple task is really attended with many difficulties, one of which consists in the varying views of botanists as to the specific validity of forms. In some families this diversity of opinion is so great as to materially affect total results. In such cases, the Conservator has endeavored to follow the authority of the latest leading specialists. Another difficulty arises from the large amount of unworked and unnamed material, which has accumulated since the early days of the Academy, some of it probably duplicating the named species.

The enumeration is not yet complete, but, as it covers about three-fourths of the collection, a tolerably fair estimate may be made of the remainder, on the basis of space occupied. The conclusion is that the phanerogamic species will not exceed 24,000. To these we must add the ferns—1018, by count —and the remaining vascular crygtogams, estimated at 120 species, and we have a total of phanerogams and vascular cryptogams of a little more than 25,000 species. Of the extent of the collection of lower cryptogams, embracing mosses, liverworts, lichens, algæ and fungi, the Conservator is at present unable to give any estimate.

Respectfully submitted,

JOHN H. REDFIELD,
Conservator.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

The meetings of the Section have been held regularly during the year, but the attendance has not been as large as formerly. There have been, however, satisfactory additions to the collections of minerals and rocks, in part by purchases made with the funds of the Section.

Respectfully submitted,

THEO. D. RAND,
Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALEONTOLOGY.

The Professor of Invertebrate Paleontology respectfully reports, that during the year he has delivered a course of lectures on paleontology and physiography, which course, as in previous years, was attended in principal part by teachers from the various schools of the city. A special course of lectures on geology, arranged by request of the Teachers' Institute of Philadelphia, was delivered before the members of that body, with an attendance ranging from one to two hundred. Six field excursions, em-

bracing points of interest in the neighborhood of the city, and extending to the terminal moraine, on the line of the Delaware and Lackawanna Railroad in New Jersey, and the "mountain colonnades" of Orange, were participated in by a fair proportion of the class.

The condition of the collections of the Academy in the department of paleontology has been materially improved during the year, a complete re-arrangement of the fossils of this country having been effected. The work of identifying and labeling has made considerable progress, and it is hoped that in a short time proper attention may be given to the rich collections illustrating European paleontology as well.

The additions during the year, which are recorded elsewhere, have been neither very numerous nor important. A fine series of Oligocene fossils from Germany, comprising nearly 200 species, has been obtained from Dr. Otto Meyer, in exchange for American Tertiary forms. The Academy is also indebted to Mr. Joseph Willcox for an extensive series of the Nummulitic rock of Florida.

Very respectfully,

ANGELO HEILPRIN,
Professor of Invertebrate Paleontology.

REPORT OF THE PROFESSOR OF MINERALOGY.

The Professor of Mineralogy respectfully reports that during the spring months of 1884, he delivered a course of twenty lectures upon the Geology and Mineralogy of Eastern Pennsylvania. The alternate lectures were given in the open air, and consisted of studies in the field at localities of geological and mineralogical interest in the vicinity of Philadelphia. At the close of the course a more extended excursion was taken to Mauch Chunk, Hazleton, and Drifton, where, through the kindness of friends, unusual facilities were offered for studying the geological structure and the methods of mining anthracite coal. A description of the "field lectures," as reported in a daily newspaper, is herewith presented. The average attendance was nearly forty persons, of whom more than one-half were ladies.

The mineralogical collection of the Academy, as shown in the accompanying Curator's report, has received a number of valuable additions. The placing of the minerals of Pennsylvania in a special case will, it is believed, not only be a convenience to visitors, but, as it becomes more complete, will stimulate a search for new mineral localities. The mineralogists of the State are particularly asked to contribute to this local collection.

As in previous annual reports, attention is again called to the need, in this department, of scientific apparatus, both for the purposes of teaching and for the prosecution of original research. A lithological microscope, a reflecting goniometer, and a Groth's universal apparatus for polarized light, are among the instruments most urgently needed.

Respectfully submitted,

H. CARVILL LEWIS,

Professor of Mineralogy.

REPORT OF THE PROFESSOR OF INVERTEBRATE ZOÖLOGY.

The Professor of Invertebrate Zoology respectfully reports that during the past year, since March, when he was placed in office, he has delivered his inaugural address on "The Study of Biology in Germany" (March 10), and six lectures on "Elementary Histology," with demonstrations.

He further reports that the collections under his charge have greatly increased, especially by the addition of a superb collection of marine sponges from the western coast of Florida, presented by Mr. Joseph Willcox. The collection was described by Henry J. Carter in the Proceedings.

A course of some twenty lectures is intended to be given in the early part of the coming year (January, February and March), the subject being "Some of the Principles of Zoology."

Very respectfully,

BENJAMIN SHARP,

Professor of Invertebrate Zoology.

REPORT OF THE PROFESSOR OF ETHNOLOGY AND ARCHÆOLOGY.

A short course of lectures on some points in general ethnology was delivered by me, immediately after my appointment as professor in April last. The subjects were :—

Prehistoric Man in America.
The Origin of the Aryan Nations.
The Progress of American Linguistics.
The Civilization of Ancient Mexico and Peru.

These lectures were public and were reasonably well attended.

After the organization of the Bureau of Scientific Information had been established, I forwarded a circular to a considerable number of persons interested in my branch, in different parts of the United States, announcing both the professorship and the Bureau, and asking them to favor the Academy with such specimens and information as would be of advantage to instruction in this department. A number of promises to do so have been received.

There has been but small increase in the collections in my department since I took charge of it. The arrangement of the cabinet leaves much to be desired, but I see no remedy for this, unless considerably more space were at my disposal, and I am well aware that the Academy is unable at present to supply this. I can obtain "for deposit" with the Academy, several very fine local collections of antiquities, were sufficient space for their proper display, and the usual guarantees of conservation, offered their owners.

Very respectfully,

D. G. Brinton, M. D.,
Professor of Ethnology and Archæology.

The election of Officers for 1885 was held, with the following result:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	Wm. C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.
	Angelo Heilprin.
Councillors to serve three years, ...	Chas. P. Perot,
	J. H. Redfield,
	S. Fisher Corlies,
	Charles Morris.
Finance Committee, . .	Isaac C. Martindale,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	George Y. Shoemaker.

ELECTIONS DURING 1884.

MEMBERS.

January 29.—John Struthers, Thomas M. Fenton, M. D., H. W. Stelwagen, M.D., D. G. Brinton, M. D., Miss Helen C. D. Abbott, William Thomson, M. D., Rev. Wayland Hoyt, D. D., Benj. R. Smith.

February 26.—Eugene W. Fiss, Francis E. Emery.

March 25.—Albert S. Bolles, Ph. D., R. W. Fitzell, Joseph W. Griscom.

April 29.—J. L. Forwood, M. D., Lewis Woolman, John Eyerman, Edward Jackson, M. D., Miss S. D. Atkinson, E. J. Wheelock.

May 27.—Henry N. Rittenhouse.

June 24.—Lieut. Thos. L. Casey, U. S. A.

August 26.—Ralph W. Seiss, M. D., Edw. P. Bliss.

September 30.—Miss Adele M. Fielde, Henry F. Osborn, John Wanamaker.

October 28.—H. La Barre Jayne, Edmund J. James, Ph. D., W. B. Scott, George Fales Baker.

November 25.—W. Henry Grant, Rufus Sargent, M. D.

CORRESPONDENTS.

January 29.—Karl A. Zittel, of Munich; August Daubrée, of Paris; Marquis de Gaston de Saporta, of Aix; Quintino Sella, of Rome; Albert Gaudry, of Paris.

March 25.—Ludwig von Graff, of Aschaffenburg; E. Renevier, of Lausanne; G. Dewalque, of Liege; Hans Bruno Geinitz, of Dresden; Henry N. Moseley, of Oxford; J. T. Burdon Sanderson, M. D., of London.

April 29.—Ernest André, of Gray, Haute Saone.

October 28.—G. Vom Rath, of Bonn; George E. Dobson, of London.

November 25.—John Ball, of London; Wm. Carruthers, of London; Rud. Leuckart, of Leipzig; Anton Dohrn, of Naples; H. Grenacher, of Halle i. S.; Alex. Götte, of Rostock i. M.; Ludwig Will, of Rostock i. M.

ADDITIONS TO THE MUSEUM.

ARCHÆOLOGY, ANTIQUITIES. IMPLEMENTS, ETC.—Joseph Leidy. Fragment of Druid stone. Avebury, Eng.
Stuart Wood. Contents of an Indian shell-heap, Indian River, Fla.
Miss A M. Fielde. Earrings of native work, Laos.
H. Beates. Aboriginal urn. Clearfield Co., Pa.
J. Willcox. Indian implements, Hernando Co., Fla.
Marquis de Nadaillac. Paleoliths, Ras-el Oued, Tunis, Africa.

MAMMALIA (recent and fossil).—W. P. Buck. Double-headed fœtal pig (*Sus scrofa*).
Phil. Zool. Society. *Macrorhinus angustirostris* (skull), Coast of California; *Cercopithecus albogularis*, Africa.
J. B. Betts. *Condylura cristata*, New Castle, Del.
Mr. Kochusperger. 8 mammalian skulls; antlers of *Cariacus Virginianus;* horns of *Rupicapra tragus, Tamias striatus, Scalops aquaticus;* skull of *Cariacus Virginianus, Ovis aries* (2); horns of *Bos bubalus*, and *Ovis aries*; human skull.

BIRDS.—Stuart Wood. Skeleton and eggs of *Pelecanus fuscus*, from Florida; skeleton of *Colymbus torquatus; Tachypetes aquila.*
Mr. Kochusperger. 39 bird skulls, *Corvus Americanus, Melanerpes erythrocephalus, Porzana Carolina*, and 12 birds' nests.
G. Cochran. *Didunculus strigirostris*, Samoa.
H. England. Embryo pigeon showing five toes.
J. Ford. Nest of *Vireo olivaceus*, Phila., Pa.

REPTILES AND AMPHIBIANS (recent and fossil).—Capt. Livermore. 20 species of amphibians and reptiles from the valley of the Rio Grande.
Harrison Allen. *Anolis principalis*, Fla.
E. Reiff. *Eutænia sirtalis*, Phila., Pa.
E. A. Sturge. *Lygosoma brachypoda*, Petchaburi, Siam.
J. Border. Vertebræ of *Mosasaurus* and crocodile; tooth of *Hyposaurus*, and fragments of turtle bones, Mullica Hill, N. J.
A. F. Gentry. *Eutænia sirtalis, Ophibolus doliatus, Aromochelys odoratus, Rana clamitans, Rana palustris*, Phila., Pa.
Wortman and Gentry. *Eutænia sirtalis, Storeria Dekayi*, and *Spelerpes ruber*, Phila., Pa.
J. Hazard. *Liopeltis vernalis*, Peacedale, R. I.
E. W. White. *Ceratophrys ornata*, pampas of Buenos Ayres, S. A.
H. Skinner. *Diemyctilus miniatus, Diemyctilus viridescens*, Adirondack and Catskill Mountains, N. Y.
Unknown. *Phrynosoma platyrhina* and *Phrynosoma Douglassi*, Humboldt River, Nev.; *Phrynosoma Douglassi*, locality unknown.

FISHES (recent and fossil).—E. F. Halliwell. *Diodon hystrix*, Barbadoes. *Halocypselus evolans.*
J. Jeanes. *Xiphotrygon acutidens*, Eocene of Green River, Wyoming.
A. F. Gentry. *Pomotis aureus, Rhinichthys atronasus, Boleosoma Olmstedi*, Phila, Pa.
Wortman and Gentry. *Prionotis lineatus*, Coast of N. J.
N. S. Schuyler. *Lagocephalus lævigatus*, Barnegat Bay, N. J.
J. Ford. *Siphostoma fusca*, Somers' Point, N. J.
Prof. Porter. Fish, sp.? Warren Co., N. J.
Mr. Kochusperger. *Hippocampus Hudsonius, Pristis antiquorum, Sphyrena zygæna, Siphostoma fusca.*
B. Sharp. *Amphioxus lanceolatus*, Bay of Naples, Italy.

ARTICULATES (Crustaceans, insects, arachnids, and myriapods, recent and fossil). – Joseph Leidy. *Eupagurus pollicaris*, Atlantic City, N. J.; *Eupagurus pollicaris* in *Natica* and *Fulgur*, Atlantic City, N. J.; *Libinia canaliculata*, Atlantic City, N. J.

J. Ford. *Ocypoda arenaria*, Atlantic City, N. J.

H. Skinner. Cocoons of *Actias Luna*, *Callosamia angulifera*, and *Platysamia Columbia;* chrysalids of *Papilio Turnus*, *Papilio troilus*, *Papilio asterias*, and *Saturnia Io*, Phila., Pa.

H. C. Brick. *Belostoma grandis*, Phila., Pa.

W. Y. Heberton. *Limulus polyphemus* (2), Cape May Point, N. J.

Mr. Beck. Trap of *Tarantula*.

H. Kingsbury. Case of insects, Blair Co., Pa.

Purchased. Casts of *Asaphus megistos* (Trilobite), showing impression of legs.

MOLLUSCA (recent).—S. F. Aaron. Five species of land shells from Texas.

Rafael Arango. Fifteen species of land, fresh-water and marine shells from Cuba, New Guinea and New Hebrides; five marine species from Cuba; four species from Cuba (types of descriptions).

S. Archer. One hundred and twenty-five species of marine shells collected by him at Singapore.

W. G. Binney. Six species terrestrial shells from N. Carolina, and five species from Georgia; seventeen species from the mountains of Western N. Carolina.

Mrs. A. E. Bush. *Helix ramentosa*, Gould, and *H. pulchella*, Müll. (introduced), from California.

Conchological Section. Sixty-six marine species collected at Singapore by Dr. S. Archer; three hundred and five trays of marine, land and fresh-water shells from Florida, Texas, etc., collected by Henry Hemphill; one hundred and twenty-five species marine shells from Singapore; ten species of land and fresh water shells (from C. F. Ancey, Marseilles).

John Ford. *Littorina irrorata*, Say, South Atlantic City, N. J.; egg cases of *Fulgur carica* and *F. canaliculata*, Brigantine Beach, N. J.; *Solen ensis*, L., Cape May, N. J.; *Cytherea convexa*, Say, Atlantic City, N. J.; *Donax fossor*, Say, and *Petricola pholadiformis*, Lam.; *Bulimus*, from Syria, *Cingula minuta*, Totten, Providence, R. I.; *Mactra solidissima*, Chemn., young, So. Atlantic City, N. J.; *Gemma Manhattensis*, Prime, Narragansett Bay, R. I.; egg cases of Nassa, and *Petricola pholadiformis*, Lam., Sea Isle City, N. J.; *Solen ensis*, L., with animals, and nidus of *Natica duplicata*, Say, Somers' Point, N. J.; fine specimen of *Turbinella scolymus*. Bahamas; *Natica duplicata*, Say, Atlantic City, N. J.; *Fulgur canaliculata*, Say, Anglesea, N. J.; *Mactra solidissima*, Chemn., and *Zirphæa crispata*, L., from same locality; *Arca pexata* and *Natica duplicata*; egg cases of *Fulgur canaliculata*, attached to valve of *Mactra;* all from Anglesea.

Isaiah Greegor. Seven marine species from the Bahamas; *Bulima intermedia*, Cantr., Florida; *Nerita peleronta*, L. Bahamas. Three marine species from Florida, and two species from the Bahamas.

Andrew Garrett. Eighty-four species of Terrestrial Mollusca, types figured in his paper on the Shells of the Society Islands, published in the Journal of the Academy, vol. ix.

W. D. Hartman. *Achatinella Sowerbyana*, and two other species of *Achatinella*.

F. L. Harvey. Seven species of fresh-water shells, Arkansas.

Henry Hemphill. Six species of Pleurotomidæ, from Florida.

Benton Holcomb. Seven species fresh-water shells, Connecticut.

J. A. Holmes. *Marginella roseida*, Redfield, from an Indian burial mound, N. Carolina.

Jos. Leidy. *Columbella lunata*, Say, Atlantic City, N. J.

E. Lehnert. One hundred and twelve trays, shells of Washington, D. C.
E. Marie. Forty five species of shells from Guadeloupe, W. I.
Isaac Massey. *Ranella pulchra*, Japan.
Wesley Newcomb. *Bythinella Monroensis*, Fraunfeld, Florida Springs, Florida.
C. R. Orcutt. Thirty-four species, California; three marine species, Lower California.
G. H. Parker. *Ommastrephes sagittatus*, N. Jersey; ten marine species, vicinity of Boston, Mass.
W. H. Rush. Wood bored by *Xylotrya fimbriata*, from Chesapeake Bay.
A. W. Robinson. *Helix bucculenta*, Gould, Norfolk, Va.
Mrs. Benj. Sharp. *Mya arenaria*, Linn., Nantucket, Mass.
Benj. Sharp. *Mercenaria violacea*, Schum., Nantucket; eleven marine species from the Mediterranean Sea; *Limax agrestis*, Linn., Germantown, Pa.
U. C. Smith. *Unio complanatus*, Solander, from branch of Maurice River, near Vineland, N. J.
F. E. Spinner. *Murex adustus*, Linn., from Bahamas; four species of Unionidæ, from New Hampshire.
L. H. Streng. *Cerithium ocellatum*, Brug., Panama; *Planorbis bicarinatus*, Say, Salem, Oregon; two species fresh-water shells from Michigan.
Southwick and Jenks. *Cingula minuta*, Totten, Naragansett Bay, R. I.
Joseph Willcox. Three marine species, and nidimental capsules of *Fasciolaria*, *Ostrea parasitica*, on mangrove branch, all from W. Coast of Florida.
H. C. Wood, Jr. *Bulimus alternatus*, Say, Valley of the Rio Grande, Texas; *Ommastrephes sagittatus*.

MOLLUSCA (fossil).—E. W. Cooper. *Belemnitella mucronata*, Cretaceous, N. J.
C. S. Bement. *Cerithium giganteum*, Fleury, France.
J. Border. Cast of *Arca*, Mullica Hill, N. J.
J. Leidy. *Ostrea Virginica*, *Buccinum undatum*, Atlantic City, N. J.
J. Ford. *Pecten irradians*, *Fulgur carica*, *Fulgur canaliculata*, *Crepidula fornicata*.
In exchange with Dr. Otto Meyer. 170 species of Oligocene shells, from Germany.

WORMS, ECHINODERMS, CŒLENTERATES AND SPONGES (recent and fossil).—J. Ford. *Caudina arenaria*, Atlantic City, N. J.; *Mellita testudinata*, Holly Head City, N. J.; Sponge, Somers' Point, N. J.; *Lepas anserifera*, Atlantic City, N. J.; *Tubularia indivisa* and Annelid, Sea Isle City.
J. Leidy. *Astrangia Danæ*, Atlantic City, N. J.
E. Potts. 12 species of American fresh-water sponges, Philadelphia, Pa.; *Meyenia Leidyi*, Philadelphia, Pa.
C. Wistar. *Serpula dianthus*, Barnegat, N. J.
J. Willcox. Six specimens of Marine Sponges, West Coast of Florida; 70 trays, containing about 50 (?) species of Marine Sponges, W. Coast of Florida.
L. Woolman. *Scolithus linearis*, Valley Forge, Pa.
G. H. Parker. *Botryllus Gouldii*, *Molgula Manhattensis*, *Dactylometra quinquecirra*, Shark River, N. J.
Lieut. Ruschenberger. Sponge, Long Island.
A. H. Smith. *Pentremites pyriformis*, Mammoth Cave, Ky.

INVERTEBRATE FOSSILS, UNCLASSIFIED.—G. H. Parker. 26 species of Cretaceous and Carboniferous fossils, from Texas; 10 species of Carboniferous fossils, Wise Co., Texas.

G. W. Holstein. 8 species of Cretaceous and Carboniferous fossils, from Texas.
J. Willcox. 15 trays of Oligocene rocks and fossils, West Coast of Fla.
T. H. Aldrich. 21 species of Tertiary fossils, from Mississippi.
W. Spillman. 4 species of Eocene fossils and 2 species of Cretaceous fossils, from Mississippi.

BOTANY (recent).—Wm. M. Canby, in charge of Division of Economic Botany of Northern Transcontinental Survey. 1013 species of plants, collected in 1883, in Dakota, Montana and Washington Territories by himself, and by F. L. Scribner, T. S. Brandegee and Frank Tweedy; 6 species collected in Maryland and Florida, by J. Donnell Smith.
A. L. Siler, Kane Co., Utah, through Thomas Meehan. 41 species plants, from Southern Utah.
Wm. H. Jeffries, West Chester, Pa. Specimens of *Gentiana campestris*, from vicinity of Geneva, Switzerland.
John H. Redfield. 130 species plants, from Atlantic and Pacific States, mostly new to Academy's Herbarium; specimens of *Corema Conradii* Torr., from the chief known localities of the United States.
John H. Redfield and Isaac C. Martindale. 9 species plants collected by C. R. Orcutt, on border of Lower California, in 1883, mostly new to the Herbarium.
Isaac C. Martindale. Ellis' 11th, 12th and 13th Centuries of North American Fungi; "Tuckahoe," or "Indian Bread," collected at Kirkwood, N. J., by Joel P. Kirkbride.
Thos. Meehan. *Sesbania punicea* B. and H., cultivated in Southern States; *Cuscuta racemosa* Mart., var. *Chiliana* Engelm., growing on Lucerne, in California, with European specimens of same, both received from Dr. Engelmann; 207 species of plants collected by him in British Columbia and Alaska, in 1883; *Aphelandra* ——, from Western Guatemala; 16 species plants, collected in Arizona, by J. G. Lemmon; Male Strobilus of *Macrozamia* ——, an Australian Cycad; Specimens of *Halesia tetraptera* L., from Mr. Meehan's garden, with specimens of an aberrant seedling from same plant, to illustrate remarks of Mr. Meehan in Proc. Acad. Nat. Sci., for 1884, p. 32.
John W. Eckfeldt. 100 species Lichens, mostly from Pennsylvani, mounted and named by himself; 132 species Lichens, from Hawaiian Islands, England, Austria, Sweden, etc., mostly new to Academy's collection.
Asa Gray. 39 species Arctic plants, collected by Dr. John Murdock, at Signal Service Station, Ooglamie, Pt. Barrow, Arctic Sea, lat. 71°; 19 species plants, collected at Copper I., and Behring's Island, Coast of Kamtschatka, by L. Stejneger, in 1882 and 1883; 101 species plants, mostly from China, collected by Ford, David, etc.; *Aster novi-Belgii* L., and variety, *Aster paniculatus* Lam., and *Aster vimineus* Lam., all from Massachusetts; 1057 species plants, mostly European, from Herbarium of Geo. Curling Joad.
G. W. Holstein, through Thos. Meehan. 59 species plants, collected in Texas, Arizona and Southern California, in 1883.
L. J. Wahlstedt, of Christianstad, Sweden, through Robert Nordbloem, of Philada. A collection of Scandinavian *Characeæ*, consisting of 31 species and numerous varieties and forms.
John Donnell Smith, of Baltimore. Md. *Hieracium Marianum*, Willd., from Garrett Co., Md., formerly confounded with *H. Gronovii* L., now restored by Gray; 26 species plants, collected by him in southern United States, in 1884.
Thos. C. Porter. 19 species plants from New Jersey and Pennsylvania.
H. J. Hunt, U. S. N., of the Arctic Relief Search Party for the survivors of the Jeannette, through Chas. E. Smith, of Philadelphia. 10 species Arctic plants, collected in 1882, near the mouth of Lena River, Siberia.

Aubrey H. Smith. Fruit of *Torreya Californica*, California; Nut of *Areca Catechu*, from S. China.
G. Howard Parker. *Usnea barbata* and *Batrachospermum moniliforme*, both from Hammonton, N. J.
W. A. Kellerman of Manhattan, Kansas. 23 species plants, collected by him in western Kansas.
Mrs. Fanny E. Briggs, Le Centre, W. T., through Thos. Meehan. 6 species plants, from Washington Terr.
Isaac Burk. *Trichinium exaltatum* Buth., Cult., native of Australia; *Gordonia pubescens*, L'Her., and *Halesia diptera*, Willd., both from Bartram's Garden.

Fossil Botany.—S. E. Paschal. Plant impressions, Triassic shale, Buckingham Valley, Bucks Co., Pa.
A. H. Smith. Wood, Gold Run Mine, Cal.

Minerals.—Joseph Leidy. White fluorite, locality unknown.
C. S. Bement. Topaz, beryl, clevelandite, apatite, zircon, montmorillonite, columbite, fluorite and orthoclase, Stoneham, Me.; curved muscovite, Branchville, Conn.
W. W. Jefferis. Melanite garnets, Frascati, Italy; blende, Santander, Spain; pyrite, Lancaster Co., Pa.; sphalerite, Alston Moor, Cumberland, Eng.; pyrite in calcite, Chester Co., Pa.
J. Binder. 9 specimens of granite, Maine.
W. B. Eltonhead. Corundum, Lehigh Co., Pa.; graphite and anthracite in cast iron; arsenio-pyrite, blende and quartz, Dakota; muscovite, Custer City, Dakota.
J. Hartman. Siderite and hematite, millerite in hematite, Antwerp, N. Y.
G. W. Fiss. Columbite, Amelia Court House, Va.
J. Border. Mica schists, from marl-pit, Mullica Hill, N. J.
J. G. Hiestand. Astrophyllite, celestite, barite and calcite, and zircon, Colorado.
J. Lea. Cancrinite, Chester Co., Pa.
H. C. Lewis. Calcite with byssolite, Chester Co., Pa.
W. Hoyt. Chalcopyrite, Chester Co., Pa.; volcanic ash, Krakatoa.
W. H. Bates. Magnetite, Marion Co., N. C.
A. R. McHenry. Pumice, Java Sea, near Krakatoa.
H. J. Smith. Cassiterite, Rockbridge Co., Va.
H. H. Eames. Azurite and malachite, Santa Rita Mts., Arizona; silver in chrysocola, Quijotoa Mts., Arizona; muscovite and uranite, Ash Co., N. C.
J. Struthers. A collection of agates, silicified and opalized woods, landscape and other marbles, fluoites, calcites, quartz crystals and other minerals, from various localitrs.
S. Wood. Fossiliferous boulder, Escuminiac River, Bonaventure Co., Canada.
Mr. Linn. Limonite (ochre), Montgomery, Ala.
P. F. Brown. Vivianite Mullica Hill, N. J.; byssolite in calcite, French Creek, Chester Co., Pa.
D. S. Martin. Coal, Discoe Island, Greenland; turba, Bahia, Brazil.
Mineralogical Section A. N. S. Barite, Cumberland, England; apophyllite and calcite, Chester Co., Pa.; crocidolite, South Africa; vanadinite, Arizona; strengite and cacoxenite, Giessen, Germany; pseudomorphs after sarcolite, Canada; priceite, Oregon; pseudocotonnite, Vesuvius, Italy; vesbite, Vesuvius, Italy; dietrichite, Hungary; struvite, Schemnitz; clausthalite, Sweden; menacannite, var. washingtonite, Litchfield, Conn.; euchlorine, Vesuvius, Italy; muscovite, barcenite, Mexico; bornite, Colorado; schraufite, Bukowina; cubanite, Cal.; kjerulfite and tschermakit, Norway.

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Erwiderung auf Herrn Prof. Dr. Hermann v. Meyer's Aufsatz:—"Der Zwischenkieferknochen und seine Beziehungen zur Hasenscharte und zur schrägen Gesichtsspalte."

Ueber die Zahl der Zähne bei den Hasenschartenkieferspalten.

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Sur la fossette vermienne du crane des Mammifères. Bruxelles, 1884.

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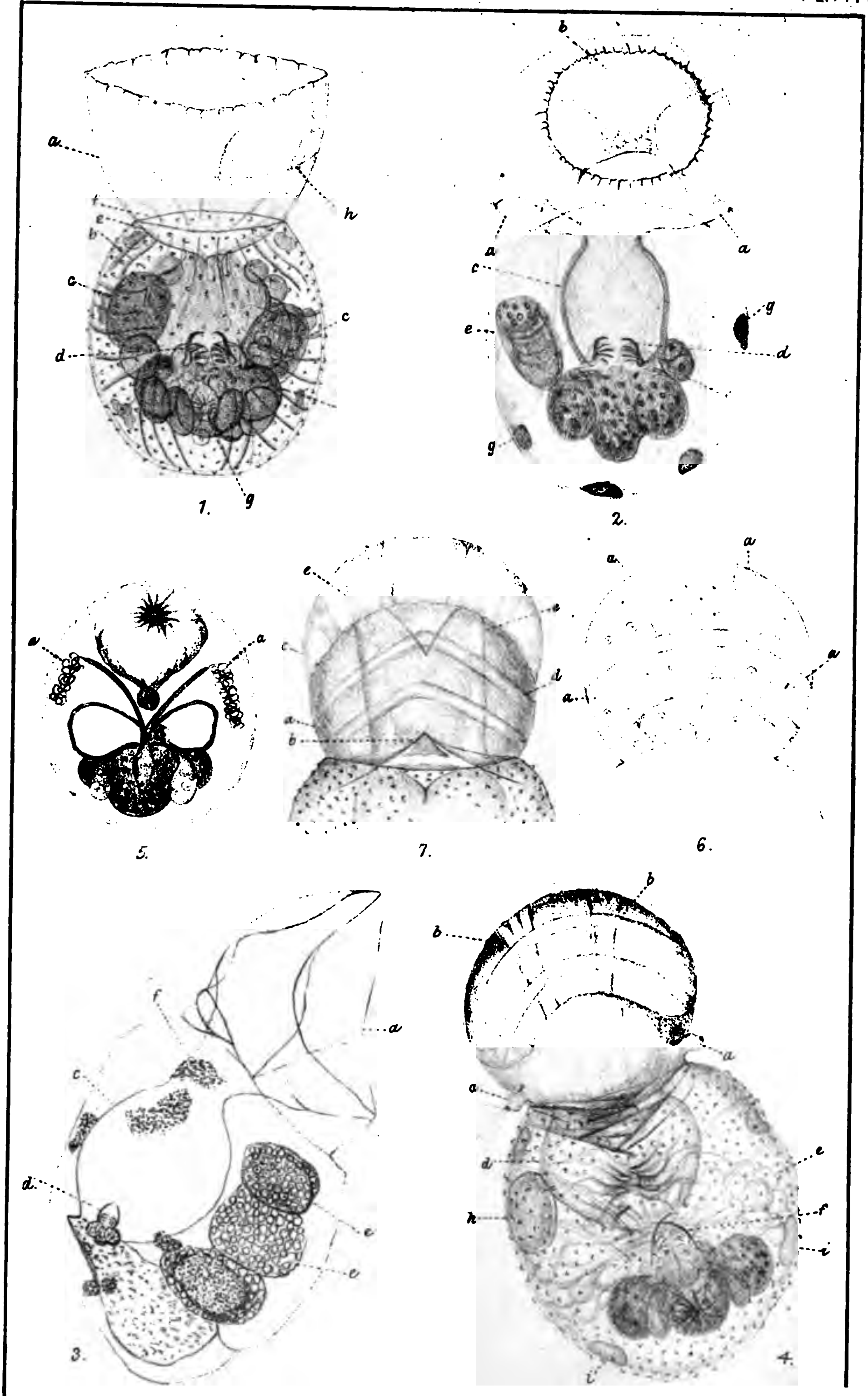

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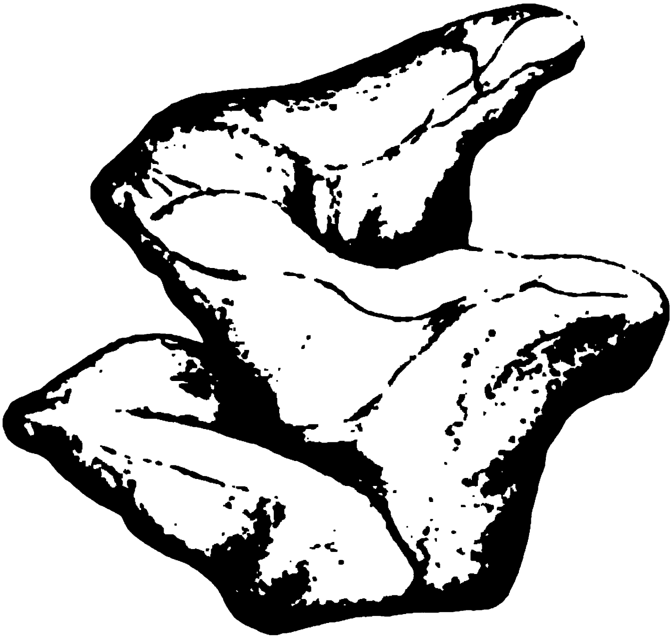

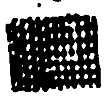

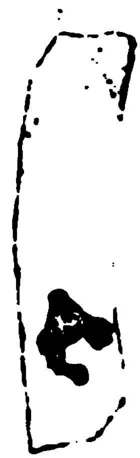

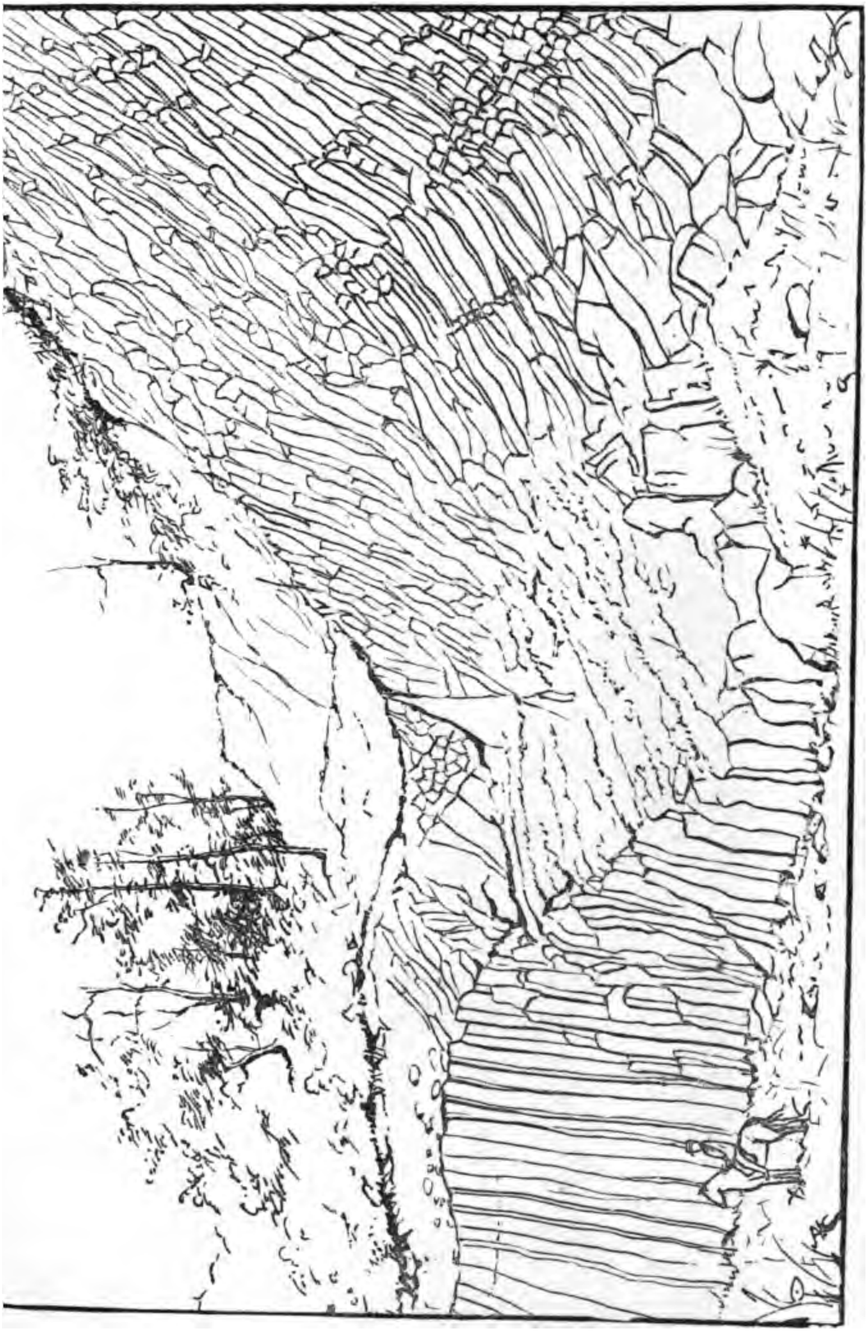

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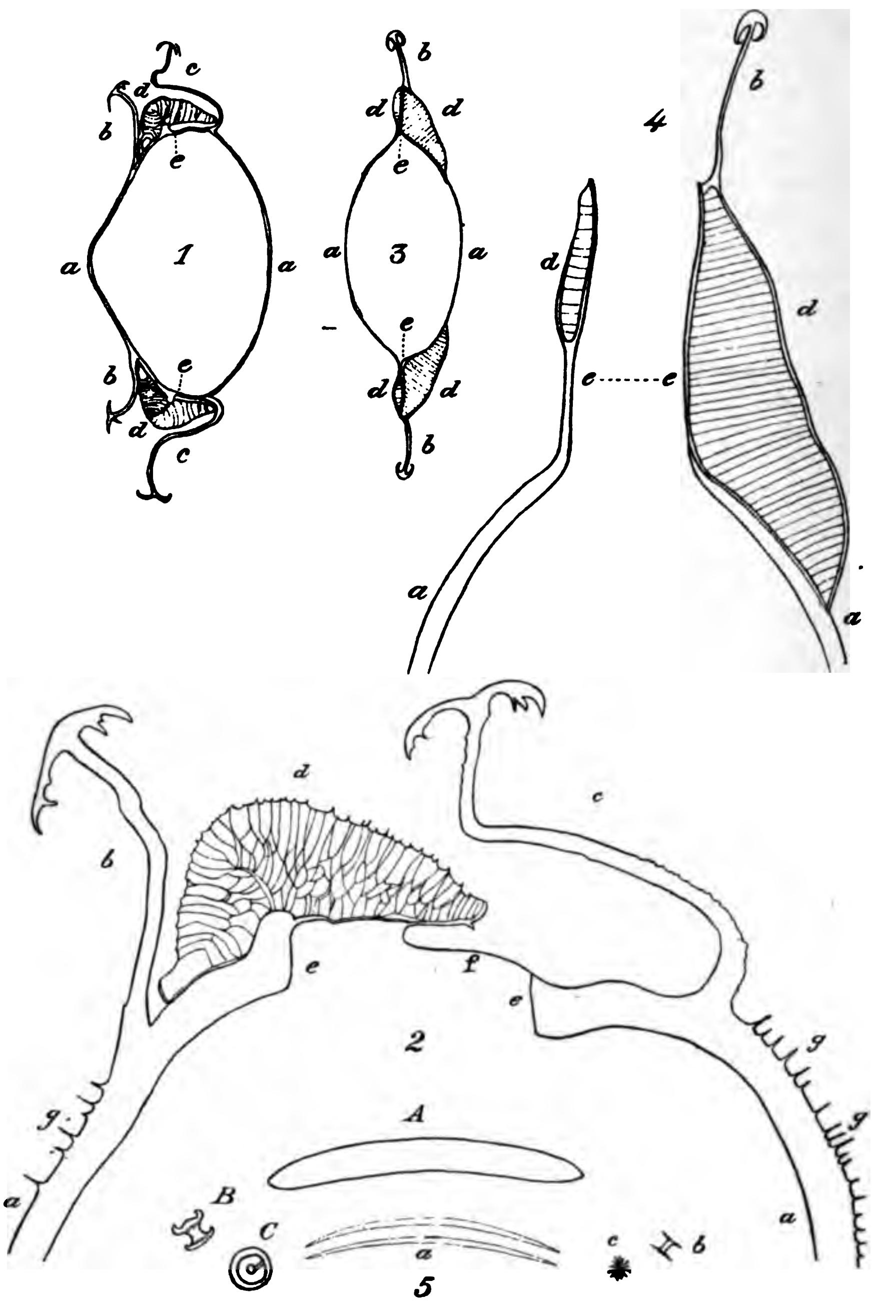

E. Potts del.

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